COMMUNITY PARTICIPATION FOR DISEASE VECTOR CONTROL

Proceedings of the ICMR/WHO Workshop to Review Research Results

3-9 February 1986

MALARIA RESEARCH CENTRE
22-Sham Nath Marg
Delhi-110054

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COMMUNITY HEALTH CELL
Bangalore – 560

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Contents

INTRODUCTORY NOTE BY DR. V.P. SHARMA vii
OBJECTIVES OF THE WORKSHOP viii
MESSAGE OF DR. U. KO KO ix
REMARKS BY PROF. V. RAMALINGASWAMI xi
ADDRESS BY PROF. M.G.K. MENON xiii

INTRODUCTION 1
Status, Distribution and Methods of Control of Vector-Borne Diseases in India 3
G.K. Sharma

ISSUES FOR CONSIDERATION 17
Promoting Community Participation 19
Fredrick L. Golladay
Issues for Consideration in Community Involvement for Disease Vector Control 27
C.P. Pant and *P.L. Rosenfield*
Establishing a Framework for Management of Community Participation in Disease Vector Control 37
Robert J. Tonn
Community-Based Integrated Vector Control—Techniques and Management for Countries of Southeast Asia Region 45
Y.H. Bang and *S. Pattanayak*

REVIEW OF RESEARCH RESULTS 57
Review of Integrated Control of Malaria in Kheda distt., Gujarat, India 59
V.P. Sharma and *R.C. Sharma*
Filariasis Control by Integrated Vector Management 85
P.K. Rajagopalan and *P.K. Das*
Malaria Control in Bombay by Legislative Measures and other Non-insecticidal Methods of Vector Control 101
P.B. Deobhankar
Control of Vector-Borne Diseases by Ecologically Safe Methods 109
S.K. Sharma
Guinea Worm Eradication—an Integrated Approach 121
Bo Elding
Vector Control at Community level in Africa 135
Jean Mouchet and *Charles Ravaonjanahary*

Approaches for Community Participation in *Aedes aegypti* control, Phanus Nikhom District, Chonburi Province 155
Boonluan Phanthumachinda, Wirat Samutrapongse, Prakong Phan-Urai, Somkiat Boonyabuncha and *Banyong Matcum*
Village level Community Participation in Malaria control with emphasis on Environmental Manipulation in Nepal 165
Shambhu Lall Shrestha
Integrated Vector Control in the Context of Community Participation in Burma 183
Nyunt Hlaing

SOCIO-ECONOMIC AND CULTURAL PERSPECTIVES 191
Fund-raising Activities for Community Participation in Malaria Control through Primary Health Care—A Papua New Guinea case 193
Sang-Bok Han
Control of Dengue Haemorrhagic Fever and Community Involvement in Indonesia 199
Thomas Suroso and *Y. H. Bang*
Role of Village Volunteers in control of Mosquito-borne diseases—Social and Economic Costs 211
Somkid Kaewsonthi and *Alan G. Harding*
Some Recent Efforts to Mobilize Community Participation in Anti-Malaria Activities in Sri Lanka 219
Kalinga Tudor Silva
Community Participation facilitated by Socio-cultural Communication 225
S.K. Sharma
Community Participation in Vector Control—Considerations based on Thai experience 231
Hongvivatana Thavitong and *Predaswat Pimpawun*
Cultural Factors Influencing Community Participation in Vector Control of Malaria and Filariasis in Malaysia 237
Haliza bt Mohd. Riji
Theoretical Models for Community Participation in Disease Control 243
M.D. Koento

PARTICIPANTS 255

Introductory Note

The strategy of residual spraying of insecticides to interrupt malaria transmission is in a state of crisis for a variety of reasons. The spraying costs are prohibitive with ecological disadvantages and social unacceptability. The government of India is spending about 45% of its health budget in the control of malaria alone and there are demands for higher and higher allocations to successfully control the disease. Recent developments in the control of mosquito vectors of diseases in India and elsewhere have shown great promise in the non-insecticidal methods of vector control. The alternate strategy is competitive costwise with several collateral benefits thus making it more appropriate, acceptable, holistic and harmonious with nature.

Taking note of these developments, the Indian Council of Medical Research (ICMR) in collaboration with the World Health Organization (WHO) organized an International workshop on community participation in disease vector control. The workshop provided a forum for the select international group to discuss results of research of various community based vector control programmes with socio-economic and cultural perspectives. Field visits were organized to provide first hand experience on the organizational and functional aspects of the community based field studies in India.

Alternatives are now emerging to minimize the use of insecticides and involve communities in the vector control programmes. We hope that the future vector control programmes would depend more and more on alternative approaches rather than on insecticides.

11.11.1986
Delhi

Dr. V.P. Sharma
Director
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Objectives of the Workshop

- To identify social and economic research issues in community participation for disease vector control;
- To review results of research projects on disease vector control through community involvement; and
- To identify and assess the approaches that have been utilized successfully in disease vector control programmes.

Message of Dr. U. Ko Ko Regional Director, WHO Regional Office for South-East Asia

It gives me much pleasure to welcome the participants in this important meeting, which is being organized by the Indian Council of Medical Research in collaboration with UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases. I am most grateful to the Government of India and to the Indian Council of Medical Research for agreeing to host this meeting and for the welcome extended to the participants.

As you know well malaria, dengue/dengue haemorrhagic fever and Japanese encephalitis, among other vector-borne diseases, continue to be of major public health importance in Asia throughout the tropical zone. The prevention and control of these diseases, which are closely linked to ecological factors, still depends mainly on anti-vector measures using insecticides. In recent years, many national vector control programmes have been impeded both technically and operationally—on account of the increased resistance of disease vectors to various insecticides and the higher cost of alternative insecticides, respectively. In view of the technical and operational problems plus the increased concern about environmental pollution caused by the extensive use of pesticides, the WHO has been collaborating with its Member Countries to promote the integrated control of disease vectors through community participation, in the context of primary health care, in our efforts to achieve the goal of "Health for All by the Year 2000".

In SE Asia region, the concept of community-oriented vector control is today well conceived to complement, and at the right time, to replace the vertical public health programmes. In a number of instances, it began with limited demonstration projects in selected areas against priority disease vectors. From such projects evolve a clear understanding of what to integrate, where to integrate, and when and how to integrate, as an approach leading to self-reliance.

Many methods of disease vector control which were commonly practiced before the DDT era depend to a large extent on the participation of the community. However, it would be useful to review the various existing innovative methods to determine which are more economical for application by the community. In promoting and motivating community participation, it would also be essential to have appropriate means in the form of motivation or incentives so that people can assume their responsibility, exercise their authority and mobilize their resources in the context of self-reliance. It is

therefore, necessary to look into the social and behavioural aspects of the individual, the family and the community in this approach for their long-lasting involvement. There is also a need to indentify priority areas of research and develop studies to operationalize the concept, in order to benefit the community in an efficient and economic manner. For the implementation of the technology, various types of manpower required should also be identified and then trained according to local needs.

I am confident that the wide range of expertise assembled at this meeting will enable important discussions on the promotion of community-based vector control programmes. I am certain that this gathering will be greatly benefited from various past experiences of diversified nature.

I wish you every success in your deliberations.

4 February 1986

Remarks by Prof. V. Ramalingaswami, Director-General, Indian Council of Medical Research

I would like to join Dr. V.P. Sharma in extending our greetings to Prof. M.G.K. Menon on his very first assignment on assuming this new position as Scientific Advisor to the Prime Minister of India. I am very happy that the occasion is one which shows the way that science and people can interact with one another and deal with the whole question of the application of scientific knowledge and technology, the devising of technological solutions within the social carrier systems of developing countries. Community participation in the application of science and technology is in fact a generic issue, a whole new area of science which is intensely interesting. It is something that forms the bedrock of our planning, especially in the 7th five year plan. I look upon this new feature as a germinal point for research involving the application of nowledge and the interface between knowledge and action. I hope that this meeting will act as an entry point into a wider developmental process.

How does one use a health base for enlarging and establishing linkages with community based organizations and how does one enlarge the scope of this to include all areas of rural development? As we all know those who have seen the slogan of "health for all" also talk of intersectoral coordination and that is going to take a very long time. How does one secure the confidence of the people, what are the entry points, what are the strategic positions along which one can help launch programmes like this? We do not have the talisman that will enable to cross the borders encroaching upon various disciplines. Interdisciplinarity is the essence of development.

Mr. Chairman, I have noticed that we have around the table here and sitting in the sidelines, many men and women from India and other countries who are deeply involved in action-anthropologists, social scientists, economists who have done very distinguished work who are enthusiastic about environmental control of vectors and who are now spearheading this movement.

The participants will stay here for a day or so, and then go to our field areas in Gujarat and Pondicherry. They themselves have very valuable experiences in their own countries in this area. The interaction which the

workshop provides should bring out some of the crucial issues in this area for further study.

More than any body else you are aware Mr. Chairman that the things that generally attract headlines are new discoveries which we find reported almost on a daily basis. What doesn't attract as much attention is work of this kind which is also equally challenging, requiring innovative approaches, equally scientific, objective and measurable.

We thought that we have this marvellous residual insecticide DDT and we had some visions of the conquest of some tropical diseases, those which are vector-borne. I remember a meeting at the Fogarty International Centre some years ago about the "Conquest of Tropical Disease Dream or Reality". We have learnt over the years that although some countries have been able to take maximum advantage of insecticidal methods and were able to control the vector-borne diseases, a good many, in fact a majority of the Third World has not been able to do so. Now that time is past; biological resistance has appeared and the problem today is somewhat more complex. In the process of developmental activities, especially today's urban development associated with an upsurge of rapid growth of newly liberated countries has posed a great many problems and accentuated the problem of vector-borne diseases. We now have this double phenomenon—a biological resistance and man-made conditions conducive for mosquito proliferation.

The Indian experiences of the last few years coupled with the experiences of other countries will, I hope show an alternative way, perhaps a better way of dealing with developmental issues in the Third World, with special reference to the control of vector-borne diseases.

Address by Prof. M.G.K. Menon, Member Planning Commission and Scientific Adviser to the Prime Minister of India

Dr. Ramalingaswami, Dr. V.P. Sharma and distinguished delegates to this workshop.

First of all, I thank you for the warm introduction and your good wishes.

I would like to start by saying that science has today a particularly important role to play in development. The actual use of science for beneficial developmental purposes, since it has to cover many different aspects (management, sociological, cultural, technical, financial etc.) can be far more complex than the discovery itself, which normally involves fewer persons driven by the intellectual challenge of work at the frontiers of knowledge.

I shall not be speaking here about the technical details of vector control or/of malaria eradication programmes. I wish to speak about the role and importance of community participation. Sitting in the Planning Commission, with responsibilities for a variety of sectors, including Health and Family Welfare, one of the basic things which I have observed is the general feeling among people that all solutions lie with the government. This notion has to be done away with, whether in regard to irrigation, health or family welfare.

I am glad that this particular workshop is focussing on a very important area of health with emphasis on research, science and technology inputs, and the role of community participation. We have, at this meeting, participants from different countries, apart from those from WHO and UNICEF. Clearly we all learn significantly from one another. Scientific meetings have always been arranged to facilitate understanding and for constructive interaction. There are many elements which are easier to communicate in this manner, rather than only through publication in scientific journals. The latter are invariably read only by specialists in specific sectors and disciplines; and here we are looking for interaction between different disciplines and with sociological implications. That is why such interaction and actual appreciation of what happens in the field are very important. We have been talking of community participation, but have not really succeeded in most of the areas

where the community itself is deeply involved, e.g., the area of human resources in general e.g., education, health, family welfare, social welfare and so on.

In the area of health, and with particular reference to Alma Ata declaration—Health for All by the Year 2000 A.D., the primary objective of Govt. should be to build up the essential infrastructure. In the family welfare programmes, the Government can ensure that all the techniques in our armoury are available to the people. The most important element in this is awareness and motivation as a result of which the people should come forward to make use of the facilities created. The same thing is true for education. We would like to ensure universal primary education. But the most important reason for providing school facilities is that children should come forward to take advantage of those facilities.

Let me now come to the specific subject of this workshop: which is the area of health and communicable diseases particularly vector-borne diseases. Government has certainly embarked on programmes involving large infrastructures in this field. That is why there has been such emphasis and expenditure on the creation of sub-centres, primary health centres, community health centres and so on.

Specifically, in the area of malaria there is a major programme: the National Malaria Eradication Programme, which is essentially based on chemical spraying techniques in the rural areas and larvicidal techniques in the urban areas. At one stage the NMEP had achieved very significant success. However, a resurgence took place and the programme had to be modified. What had been achieved as significant success now appears to be a fairly stagnant situation; as one begins to discover major residual components of vectors and parasites which are resistant to commonly used chemicals and drugs. The question is whether these chemical methods by themselves can eliminate the problem once and for all: one has also to keep in mind the large financial outlays involved, first in the use of insecticides like DDT, and as resistance develops, one has to get on to more expensive alternatives such as HCH and Malathion etc.

In my view, this is an area where people are deeply concerned about the nuisance of mosquitoes and the morbidity/mortality associated with the disease; they must therefore be involved in eradicating the disease. There are other programmes such as integrated rural development where attempts have been made to mobilize young people. There are also individual programmes launched in the areas of social forestry, and improvement of the environment. In each one of these the people are the direct beneficiaries; and the programmes have to be conducted. The lowest cost solution is through their involvement where they live.

One of the biggest problems in the country today is large-scale deforestation. The major responsibility of the ecologist is to reverse this trend.

Afforestation programmes fall under different categories; there are block plantation to be carried out in fresh areas which are the responsibility of forest departments; and their plantations under social forestry. One could ask whether the latter should be executed by the Government. In this case, with a large number of Government employees mobilized the costs would be high; also local support needed for survival of such plantation would be necessary. The people must be made to understand the importance of this programme since as far as rural India is concerned, it is the green cover which provides fuel; if firewood is not available in their vicinity they have to travel long distances to obtain it. Indeed urban areas also depend on fuel wood brought by transport from great distances. The people have a feeling for the need for such afforestation particularly the women, but they need infrastructural support in raising nurseries etc.

Similarly, there is a growing awareness that mosquitoes are not only unpleasant but also create health problems. A number of other factors come into play in malaria transmission e.g., migration of rural population to cities, haphazard growth of slums and the rapid development of insanitary, unhygienic conditions. Rapid development calls for an increase in agricultural production: irrigation schemes are launched to support such production and then there are undesirable environmental consequences. Similarly, industrial development attracts large labour forces which may come from different places, some of which being malaria endemic belts. A whole range of diverse activities essential to economic development thus take place; and very often, because of the desire to do things rapidly or because of resource constraints, some of the basic elements of the environment start to degenerate.

The primary health delivery system should involve a voluntary force with the Government providing the infrastructural basis. What holds good for afforestation is also true in the area of vector control. For true success to be achieved it is essential for the community to be fully involved.

Today there is great concern about vectors and the increase in vector population, as well as their resistance to insecticides and its consequences. That is why one needs an alternate strategy, namely control at source through environmental approaches. There are several areas, particularly one in Gujarat state in Nadiad, Kheda where the Malaria Research Centre has been working, and other in Pondicherry where the Vector Control Research Centre has worked, efforts have been made to involve the people; and try to approach the problems of vector control through measures which are not the traditional insecticidal methods. I have not only seen the work done at these places, but also talked to a lot of people who come from these areas.

They are extremely positive about the transformation in the quality of the environment and reduction in the disease. People have begun to understand that malaria is transmitted by mosquitoes; and this message should spread;

schools should also be involved. One needs to build up a tempo among the people, and Government has to come into this in a promotional and catalytic sense.

The Integrated Rural Development Programme (IRDP), aims to bring a person above the poverty line by providing an asset from which there is a return. Certain aspects of vector control can be made productive e.g., the rearing of edible fishes along with larvivorous fishes. A water body arranged to such a person can be an asset which yields a livelihood, and in the process, is kept clean. Minor earthworks, social forestry, controlling seepage along canals and plantation of swampy/marshy land are all employment oriented and can be covered under the National Rural Employment Programme and Rural Landless Employment Guarantee Programme. They have tremendous social relevance because they generate employment along with raising the standard of living of the people and obtain a better environment.

So, first of all, people have to be made to appreciate that many diseases such as malaria are aggravated by poor environmental conditions; they must understand that the solution to this problem lies in their hands; hence they should contribute to activities related to vector control by environment. Secondly, the programme does not have to be only an outflow, but it can be one in which wealth can be generated for the community, whether in terms of fish, or in terms of biogas and so on. Finally, Government funds are available for this, not necessarily from only one sector but from other sectors also, for example IRDP can contribute to the programme to help people rise above the poverty line. Therefore, one needs to correlate at a decentralized level which is appropriate for that particular area.

The efforts which I have seen in Kheda promise well in the area of vector control. I would like to express my appreciation of the efforts of ICMR, particularly Malaria Research Centre and VCRC, in embarking on this effort, and not only making a showpiece today but creating thereby a durable asset of value to the community for the future.

As Dr. Ramalingaswami mentioned, the high visibility area of science, which is reported in the newspapers, and showpieces, where one can take visitors around, are not the totality of the scientific effort. The application of science should be intensive at the grassroot level. The extension of the programme to Haldwani, Shahjahanpur, Jabalpur, Behrampur and few other places will bring in a whole range of completely different terrains and sociological aspects.

The general tendency is for scientists to concern themselves only with what is going on in the laboratories. But when you want to finally get an output of major consequence to society; one needs to have a delivery structure; to translate the scientific work into production and services; and this is where

some of our greatest weaknesses lie. This is particularly important in the developing countries, because in developing nations not only is there a large population, but also a rapidly growing population, and one wants to fulfill their aspirations. This can be done both by using existing knowledge and through advanced research involving the generation of new knowledge. The delivery system is of the greatest importance. The area which Dr. Ramalingaswami mentioned of interdepartmental and intersectoral cooperation is very necessary at present.

WHO is also concerned with research programmes in certain areas of tropical diseases. I am very glad to see a large number of papers in this workshop which not only relate to work being done in India but also in other countries.

The greatest resource that exists in any country is the human resource, and we have to bring this resource into play for the sake of development, because development is for them. The people have to be mobilised. The initial investment on this would be well worth it because after the tempo builds up, one can find expenditure reduced as one gets more educated, skilled and above all healthy people who are able to do things for themselves.

I am happy to be here, not as an expert in biomedical science or on vector control but to think aloud about the many things that call for community participation. The keywords in national development are *implementation* and *large-scale.* Without these the world of research becomes remote from society. Great scientific successes will by themselves not bring development. In this respect community participation in disease vector control can set a great example on the social relevance of science.

I would like to conclude with a quotation from Albert Einstein, who remarked and I quote: "the concern for man and his destiny must always be the chief interest of all technical effort. Never forget it among your diagrams and equations".

INTRODUCTION

Status, Distribution and Methods of Control of Vector-Borne Diseases in India

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INTRODUCTION

In his social evolution Man faced many problems. One of the major problems was his struggle against insect pests. On one hand he had to protect his stored food material against pest invasion and on the other hand he had to take measures against the insects that introduced disease organisms in his system.

In prehistoric times individual or group retreat was one of the methods for survival. A few important discoveries made during late 19th century viz., demonstration of micro-filaria in blood by Lewis in 1872 and malaria transmission by Sir Ronald Ross in 1897 opened up research under several disciplines which progressively improved comprehension of filaria, malaria and other insect-borne diseases transmitted in the community.

The arthropods affecting human health have certain common features which are:

(i) Localised sites of breeding;
(ii) Feeding and resting habits;
(iii) Sharing of human habitat in a characteristic manner; and
(iv) Dependence on blood feeding for survival and species propagation.

Sharing of man's immediate environment and/or man's own activities taking him to the habitats occupied by the blood sucking insects distinctly demarcate them from pests of agriculture. Often the pest nuisance affecting human health is a by-product of human activities; for example, filaria and malaria in urban areas are glaring examples of the diseases associated with concentration of humanity.

Control of vector-borne disease—development of methodology

In the prehistoric period the caveman used the smoke of certain plant leaves as protective methods against mosquito bite. When it was discovered that only certain species of anopheline mosquitoes transmit malaria and that they are ecologically dependent on specific conditions which are required for their perpetuation and survival, a planned anti-vector/disease control method based on the principle of species sanitation was developed. This includes; (i) site selection for building housing complexes, (ii) drainage, (iii) screening of dwellings, (iv) oiling water collections etc. With the discovery of the insecticidal property of pyrethrum and Paris green it was possible to integrate chemical control into the existing technology. The large-scale implementation of antilarval control in specific areas was carried out during mid'30s and mid'40s. The discovery of DDT was an outstanding advancement towards the control of vector-borne diseases in a more effective and economical manner in the rural areas. However, the development of insecticide resistance in vectors as a consequence of the large-scale use of insecticides seriously impeded the progress of the control of insect-borne diseases.

Development of insecticide resistance in vectors renewed research efforts to find and utilise biological control agents such as predators, parasites and pathogens. Such vector control methods are still in the process of development.

Basically the control of vector-borne diseases revolves around the interruption of transmission by vectors.

(i) Depending on the life cycle of the parasite in the vector, which may be cyclico-propagative or cyclico-developmental and the time taken for development of extrinsic cycle, methods are directed towards reducing the man-mosquito contact coupled with reduction in the longevity of the vector so as to ensure interruption of transmission. Methodology adopted comprises of spraying the resting places of vectors by residual insecticides to which they are susceptible.

(ii) The second method for control of vector-borne diseases involves species sanitation. It is usually very difficult to implement and enforce species sanitation unless the environmental conditions are conducive. Attempts were crowned with success for control of malaria and other diseases in very small limited areas like islands. However, in tropical areas, where vector breeding is of extensive nature, the implementation of these methods in large rural areas is not economical for control of vector-borne diseases.

MALARIA

Endemicity

Except for areas situated 5000 ft. above sea level malaria is endemic all over India. The endemicity varies from place to place depending on conditions

suitable for development of malaria vector as well as its longevity. During the 50s and early 60s the problem of malaria in rural areas was much bigger as compared to urban areas.

Vector

Out of the 51 anopheline species, six are considered vectors of primary importance. These are *A. culicifacies, A. fluviatilis, A. minimus, A. philippinensis, A. stephensi* and *A. sundaicus*. Four other species viz., *A. annularis, A. balabacensis, A. varuna* and *A. tessellatus* transmit malaria in limited geographic areas.

Control

Prior to 1946, malaria control activities were confined to environmental measures and antilarval operations in areas of industrial and strategic importance. The feasibility of malaria control by spraying with residual insecticide-DDT was demonstrated through pilot projects taken up between 1946 and 1952. In 1953, a National Malaria Control Programme was launched in areas of socio-economic, industrial and agricultural importance covering a population of more than 165 million. Later in 1953, as a part of the global policy of WHO and encouraged by the success of NMCP, the National Malaria Eradication Programme was taken up. By 1965, the incidence of malaria was brought down to one lakh cases, against 75 lakhs per annum prior to 1952. No deaths were recorded due to malaria in 1965 as against 0.8 million deaths due to malaria in 1952.

In subsequent years, resurgence of malaria took place. This was not unique to India. A similar phenomenon was observed in other neighbouring countries. A large number of maintenance and consolidation phase areas were involved in malaria resurgence from these areas. Regular insecticidal spray was withdrawn earlier. The reasons of this resurgence have been extensively documented. However, the major factor was shortage of insecticide and inadequate development of health infrastructure. By 1977, it became obvious that eradication of malaria cannot be achieved and the immediate objective under the Modified Plan of Operation was revised to prevent mortality and reduce morbidity. The main approach was to control/contain malaria with the ultimate objective of eradication as and when appropriate technology for the same was available.

As a result, malaria incidence in the country has been reduced from the all time high figure of 6.4 million cases in 1976 to 2.18 million cases in 1984 (Tables 1 and 2).

The three major problems connected with malaria control were identified as; (a) an increase of malaria incidence in urban areas, (b) emergence of vector resistance to insecticide specially in rural vector *A. culicifacies* and urban vector *A. stephensi*, and (c) emergence of strains of *P. falciparum* resistant to chloroquine.

Table 1. Incidence of malaria

Year	Population in million	Number of malaria cases per year (in million)	Percentage population with malaria per year	Number of deaths
1947	344.11	75.0	2.18	8,00,000
1965	466.00	0.100 (−99.866)	0.02	nil
1976	575.00	6.4 (−91.461)	1.11	59
1984	710.4	2.18 (−97.09)	0.31	247*

*Due to improvement in reporting.
Figures in parentheses are per cent reduction over incidence in 1947.

(a) The problem of urban area was dealt with by intensifying antilarval operations in urban areas with chemical larvicides, biological methods and water management. At present 132 towns are sanctioned under the scheme.

Depending on the type of water collection and its usage, the following larvicides are recommended on the scale indicated below.

For metropolitan cities

1. Mosquito larvicidal oil — 700 kilolitres
2. Paris green —1680 kilograms
3. Pyrethrum extract 2% —1406 litres*
4. Kerosene oil — 28 kilolitres*
5. Temephos — 500 litres
6. Fenthion — 500 litres
7. Pyrosene oil — 25 litres

For towns other than metropolitan cities

1. Mosquito larvicidal oil — 0.5 litre per capita
2. Paris green —1200 kilograms per million population
3. Pyrethrum extract — 1.0 kilolitres per million population*
4. Kerosene oil — 20 kilolitres per million population*
5. Temephos — 0.5 kilolitres per million population
6. Fenthion — 0.5 kilolitres per million population
7. Pyrosene oil — 0.5 litre per capita

*for indoor space spray.

(b) The problem of resistance to DDT was first reported from Gujarat/Maharashtra border in the year 1959 in *A. culicifacies*, the main rural vector. Since then, systematic studies on vector resistance have been conducted all over the country for the last three decades. The status of

Table 2. Details of achievements under NMEP 1961 onwards epidemiological situation at a glance

Year	Population (in mil.)	BSE (in mil.)	Total no. of Pos.	Total no. of Pf	Difference % (+) (−) to Pos. cases	Difference % (+) (−) to Pf cases	ABER	API	AFI	SPR	SfR
1961	374	13.10	49,151	17,141	—	—	3.50	0.13	0.046	0.375	0.131
1962	406	26.10	59,575	16,674	(+)21.21%	(−) 2.72%	6.43	0.15	0.041	0.228	0.064
1963	426	38.70	87,306	22,750	(+)46.55%	(+)36.44%	9.08	0.20	0.053	0.226	0.059
1964	455	44.46	112,942	31,490	(+)29.36%	(+)38.42%	9.77	0.25	0.069	0.254	0.071
1965	466	40.66	99,667	26,163	(−)11.75%	(−)16.92%	8.73	0.21	0.056	0.245	0.064
1966	476	39.83	148,012	39,618	(+)48.51%	(+)51.43%	8.37	0.31	0.083	0.372	0.099
1967	489	40.41	278,214	61,984	(+)87.97%	(+)56.45%	8.27	0.57	0.127	0.688	0.153
1968	502	41.98	274,634	92,714	(−) 1.29%	(+)49.58%	8.37	0.55	0.185	0.654	0.221
1969	514	41.82	347,975	103,217	(+)26.70%	(+)11.33%	8.14	0.68	0.201	0.832	0.247
1970	527	40.95	694,017	100,115	(+)99.44%	(−) 3.01%	7.77	1.32	0.190	1.694	0.244
1971	535	40.42	1,322,398	148,683	(+)90.54%	(+)48.51%	7.56	2.47	0.278	3.269	0.368
1972	547	42.80	1,428,649	142,177	(+) 8.03%	(−) 4.38%	7.82	2.61	0.260	3.645	0.330
1973	559	42.45	1,930,273	265,154	(+)35.11%	(+)86.50%	7.59	3.45	0.474	4.547	0.625
1974	568	45.45	3,167,658	476,922	(+)64.10%	(+)79.87%	8.01	5.58	0.840	6.970	1.049
1975	568	51.82	5,166,142	729,251	(+)63.09%	(+)52.91%	9.12	9.09	1.284	9.969	1.401
1976	575	55.98	6,467,215	753,713	(+)25.18%	(+) 3.35%	9.73	11.24	1.311	11.553	1.346
1977	587	57.01	4,740,930	461,484	(−)26.69%	(−)38.77%	9.71	8.08	0.786	8.316	0.809
1978	609	60.46	4,144,385	548,567	(−)12.58%	(+)18.87%	9.93	6.81	0.901	6.855	0.907
1979	625	61.42	3,064,697	558,423	(−)26.05%	(+) 1.80%	9.82	4.90	0.893	4.990	0.909
1980	643	67.17	2,898,140	588,011	(−) 5.43%	(+) 5.30%	10.45	4.51	0.914	4.315	0.875
1981	658	67.84	2,701,141	589,591	(−) 6.80%	(+) 0.27%	10.31	4.11	0.896	3.982	0.869
1982	678	65.03	2,182,302	551,057	(−)19.21%	(−) 6.54%	9.59	3.22	0.813	3.356	0.847
1983	689	64.29	2,018,605	600,964	(−) 7.50%	(+) 9.06%	9.32	2.94	0.876	3.140	0.935
1984	710	66.35	2,184,446	655,454	(+) 8.21%	(+) 9.06%	9.34	3.08	0.927	3.29	0.990
1985											
1986											

resistance of *A. culicifacies* to different insecticides namely DDT, HCH and malathion is given (Fig. 1).

DDT resistance is widespread practically all over the country and so is resistance to HCH, while resistance to malathion is confined to a small pocket

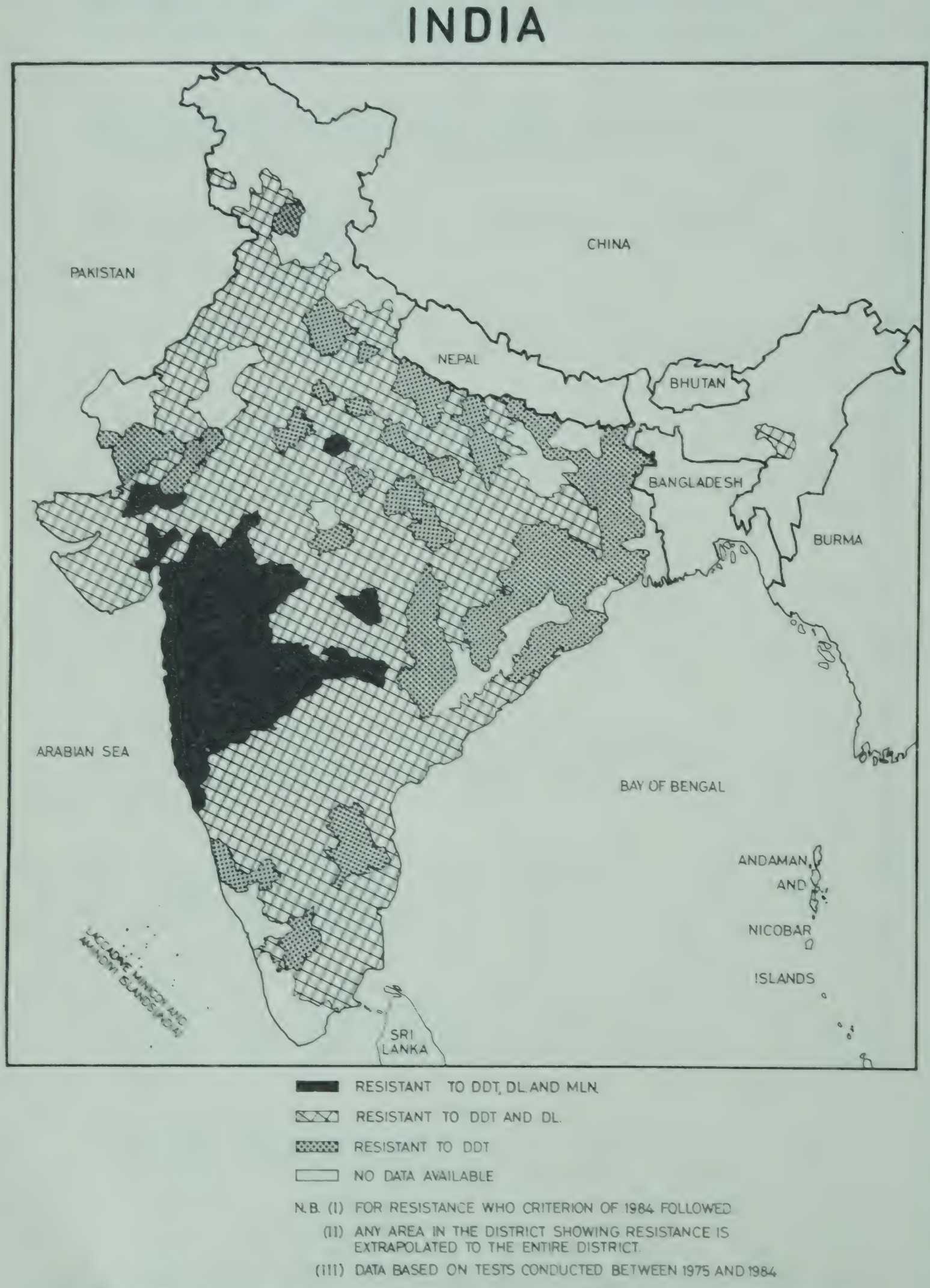

Fig. 1: Areas showing resistance of *A. culicifacies* to DDT, Dieldrin and Malathion.

of Gujarat/Maharashtra border in western part of the country and in small areas of Andhra Pradesh and Madhya Pradesh (Fig. 1).

In an earlier phase of the Eradication Programme, change of insecticide was advocated on the basis of the susceptibility status results based on WHO technique.

Another factor which contributed towards changeover to HCH was short supply of DDT in late '60s and availability of HCH which was used for focal spray in certain areas. Later on when some of these areas were reverted for regular spray operations HCH spray was continued in these areas.

Recently, the concept for change of insecticide has been modified and only if epidemiological impact is not obtained in the areas with the existing insecticide coupled with resistance observed in WHO field tests to the insecticide in use, a change of insecticide is advocated. At present (1985) out of 350 million population under insecticidal spray (2 API and above), 215 million is under DDT, 113 million under HCH and 20 million under malathion.

Two rounds of DDT at the rate of 1 gm/m^2 and three rounds each of HCH at the rate of 0.2 gm/m^2 and malathion at the rate of 2 gm/m^2 are given for control of malaria covering the transmission period. In special areas of perennial transmission a special round is given to cut down transmission. In project areas more frequent spraying is conducted for prevention of focal outbreaks. In these areas all temporary structures are sprayed immediately when they come up and later included in regular spray operation (Table 3).

Trials with other insecticides

In areas where the rural vector *A. culicifacies* is resistant to DDT and HCH, small-scale field trials were carried out in Haryana, Gujarat and Maharashtra with fenitrothion—an insecticide which has not been used in public health on a large-scale in the country so far. The results were encouraging. It was also tried in Meghalaya, where *P. falciparum* is a predominant infection. Similarly, in areas where *A. balabacensis*, an exophilic vector, transmits malaria, pirimiphos methyl has been tried with encouraging results. A new insecticide, deltamethrin synthetic pyrethroid, (which has also not been used in public health in India) is being investigated as a residual insecticide for control of malaria by a research group in the country.

FILARIA

Lymphatic filariasis caused by *Wuchereria bancrofti* is a widely distributed infection affecting people residing both in the urban and rural areas. The other lymphatic filariasis caused by *Brugia malayi* is exclusively a rural infection with restricted distribution, its large tract being the coastal areas of Kerala. There is no animal reservoir for either of the infections in India.

Table 3. NMEP spray history and insecticide consumption from 1958 to 1983

Year	Pop. under NMEP operations	Pop. under Attack Phase- to be sprayed	Percentage of total pop. to be sprayed	Pop. covered with spray	Percentage coverage		Insecticide (MT) consumed in terms of 75% DDT		Total Insecticide consumed in terms of 75% DDT
					Of total population	Of projected population	Attack Phase areas	C&M areas (5MT per unit)	
1958	396	276	69.7	198.3	50.1	72.0	14878.0	—	14878.0
1959	405	335	82.7	287.2	70.9	85.7	21544.3	—	21544.3
1960	414	344	83.0	412.3	99.6	120.0	30923.1	—	30923.1
1961	424	354	83.5	350.7	82.7	99.0	26307.3	—	26307.3
1962	435	278	64.0	262.2	60.3	94.3	23598.9	702.5	24301.4
1963	445	185	41.6	127.3	28.6	68.8	11458.2	1141.5	12599.7
1964	455	120	26.4	130.7	28.7	109.0	11763.0	1440.0	13203.1
1965	466	105	22.5	100.48	21.6	95.7	9043.7	1507.5	10551.2
1966	476	83	17.4	56.36	11.8	67.9	5636.2	1603.5	7239.7
1967	489	83	16.9	52.49	10.7	63.2	5249.5	1623.5	6873.0
1968	502	141	28.0	94.2	18.7	66.8	9419.8	1401.5	10821.3
1969	514	136	26.5	109.17	21.2	80.3	10917.9	1428.5	12346.4
1970	527	136	25.8	83.4	15.8	61.3	8339.5	1440.0	9779.5
1971	535	131	24.5	95.6	17.8	72.9	9560.1	1466.0	110261.1
1972	547	132	24.1	95.99	17.5	72.7	9599.4	1474.0	11073.4
1973	559	135	24.1	113.37	20.3	83.9	11337.0	1479.0	12816.7
1974	568	141	24.8	91.72	16.1	65.0	9172.6	1479.0	10651.6
1975	568	141	24.8	126.4	22.2	89.6	12664.0	1479.0	14143.0
1976	575	141	24.5	109.37	19.02	77.6	10937.6	1479.0	12416.6

Contd.

Table 3 (*Continued*)

Year	Pop. under NMEP operations	Pop. targeted for spray	Percentage of total pop. targeted for spray	Pop. covered with spray	Percentage coverage		Insecticide used in terms of MT of 75% DDT
					Of total population	Of targeted population	
1977	587	251.0	42.8	174.27	29.7	69.4	17427
1978	609	267.96	44.0	150.18	24.7	56.0	15018
1979	625	284.86	45.6	125.61	20.1	44.1	12561
1980	643	314.7	48.9	153.25	23.8	48.7	15325
1981	658	324.03	49.2	157.15	23.9	48.5	15715
1982	678	332.12	48.9	183.67	27.1	55.3	18367
1983	686	340.41	49.6	173.82	25.3	51.0	17382

Note: 1. During 1959 to 1961: 140 million population residing in hypoendemic areas and brought under attack phase received only one round of spray.
2. From 1958 to 1976: calculations in respect of percentage coverage of population are based on insecticide supplies.
3. From 1977: under Modified Plan of Operation the percentage coverage of targeted population above 2 API has been calculated on actual yearly consumption of different insecticides as has been reported by the States.

Vectors of filaria

Filaria infection with *W. bancrofti* is transmitted by *C. quinquefasciatus*, while *Brugia malayi* is transmitted by *Mansonia* species. The breeding habits of these two vectors are vastly different. *C. quinquefasciatus* breeds mostly in water polluted with organic matter, while *Mansonia* breeds in water collections where aquatic vegetation of specific types such as *Pistia*, *Salvinia*, water hyacinth, etc., grow in large volumes. The vector *C. quinquefasciatus* is resistant to DDT, HCH and Malathion in some places. The precise pattern of resistance and its degree has not been adequately delimited so far. However, studies indicate that it is resistant to insecticides all over the country. *Mansonia annulifera* and *Mansonia uniformis* are still found to be susceptible to insecticides in most parts of the country.

Surveys carried out showed the absence of indigenously acquired *W. bancrofti* infection in Arunachal Pradesh, Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Manipur, Mizoram, Punjab, Sikkim and Tripura. All other states are endemic for filariasis. In 1985, it was estimated that 342 million population is exposed to the risk of filaria. Of these 90 million is in urban and 252 million is in rural areas (Table 4).

Table 4. Statewise estimated population exposed to the risk of filariasis, microfilaria carriers and chronic filaria cases as in 1981

Sl. No.	States/U.Ts.	Population at risk			Microfilaria Carriers	Diseased persons
		Total	Rural	Urban		
1.	Andhra Pradesh	40.40	30.60	9.80	3.17	1.11
2.	Assam†	7.84	7.00	0.84	0.30	0.07
3.	Bihar	37.09	31.21	5.88	3.25	4.40
4.	Gujarat	13.82	8.31	5.51	0.87	0.11
5.	Karnataka	8.91	6.83	2.08	0.60	0.06
6.	Kerala	25.40	20.63	4.77	1.98	1.90
7.	Madhya Pradesh	17.79	14.47	3.32	0.53	0.06
8.	Maharashtra	11.68	‡	11.68	0.73	0.14
9.	Orissa	20.44	18.12	2.32	1.91	1.17
10.	Tamil Nadu	29.14	19.53	9.61	1.95	1.01
11.	Uttar Pradesh	79.93	62.48	11.45	5.70	5.78
12.	West Bengal	15.69	1.48	14.21	0.69	0.02
13.	A & N Islands	0.19	0.14	0.05	0.01	—
14.	Lakshadweep	—	—	—	—	—
15.	Pondicherry	0.60	0.29	0.31	0.03	0.01
16.	Goa	1.08	0.73	0.35	0.01	0.001
17.	D & N Haveli	0.10	0.09	0.01	0.0065	0.0002
	TOTAL	304.10	221.91	82.19	21.7365	15.8412

†Estimated as there was no census in 1981.
‡Only urban areas surveyed.
Figures are in millions.

Filaria control

The control of filariasis is at present restricted only to the urban areas. Methods used are recurrent antilarval measures using weekly application of larvicides and taking up measures towards reduction of mosquito breeding sources and deployment of larvivorous fish wherever possible. At present 190 control units are functioning in as many towns. Twenty seven survey units are engaged in carrying out delimitation of disease in the endemic states.

Besides, experimental studies have been taken up to develop a simple and effective strategy for control of filariasis in the rural population which is outside the National Filaria Control Programme, due to vector resistance to insecticides. These studies include detection of microfilaria carriers and their treatment. Research is being carried out in three rural pilot projects in the districts of Srikakulam (Andhra Pradesh), Bulsar (Gujarat) and Jaunpur (Uttar Pradesh). Another experiment to control filaria with DEC, a microfilaricidal drug mixed in common salt and distributed to the affected community is being tried in Karaikal in the Union Territory of Pondicherry.

During 1984, 90 per cent of the control units showed reduction in the microfilaria rate as compared to the baseline data.

KALA-AZAR

The states of Assam, West Bengal, parts of Tamil Nadu, North Bihar, Orissa and eastern parts of Uttar Pradesh were the main endemic foci. Presently the disease is mainly restricted to Bihar and West Bengal in endemic form. However, stray cases are encountered in Assam, Uttar Pradesh, Jammu and Kashmir, Gujarat and Tamil Nadu (Table 5).

Kala-azar vector and control

The reported vector for Kala-azar is *Phlebotomus argentipes.* This vector is susceptible to DDT. Control methodology consisted of spraying two rounds of DDT each at a dosage of 1 gm/m^2 up to a height of 6 ft.

JAPANESE ENCEPHALITIS

NMEP Directorate also monitors the incidence of Japanese encephalitis in the country. *Culex vishnui* group particularly *C. tritaeniorhynchus* is the major vector. In general, the vector is susceptible to DDT. However, in some areas evidence of resistance to DDT has been found.

Control of Japanese encephalitis

No regular control measures are envisaged for the control of the disease because of its obvious epidemiological characteristics. Whenever there is an outbreak, spraying of insecticides, DDT/HCH, fogging/ULV with malathion

Table 5. Kala-azar cases reported by states/union territories, 1984 & 1985

Sl. No.	Name of the States/U.Ts.	1984		1985		Reported upto
		Cases	Deaths	Cases	Deaths	
1.	Assam	—	—	—	—	Sept.
2.	Arunachal Pradesh	—	—	—	—	Sept.
3.	Andhra Pradesh	—	—	—	—	Nov.
4.	A & N Islands	—	—	—	—	Dec.
5.	Bihar	12224	65	10171	28	Nov.
6.	Chandigarh	—	—	—	—	Dec.
7.	Delhi	1*	—	1*	—	Nov.
8.	D & N Haveli	—	—	—	—	Dec.
9.	Gujarat	—	—	—	—	Nov.
10.	Goa, Daman & Diu	—	—	—	—	Dec.
11.	Haryana	—	—	—	—	Nov.
12.	Himachal Pradesh	—	—	—	—	Aug.
13.	Jammu & Kashmir	—	—	—	—	Aug.
14.	Karnataka	—	—	—	—	Nov.
15.	Kerala	—	—	—	—	July
16.	Lakshadweep	—	—	—	—	May
17.	Madhya Pradesh	NA	NA	NA	NA	..
18.	Meghalaya	—	—	—	—	Nov.
19.	Mizoram	—	—	—	—	Nov.
20.	Manipur	—	—	NA	NA	..
21.	Maharashtra	—	—	—	—	Aug.
22.	Nagaland	NA	NA	NA	NA	..
23.	Orissa	NA	NA	NA	NA	..
24.	Pondicherry	—	—	—	—	Nov.
25.	Punjab	—	—	—	—	Nov.
26.	Rajasthan	—	—	—	—	June
27.	Sikkim	—	—	—	—	Oct.
28.	Tripura	—	—	—	—	Sept.
29.	Tamil Nadu	2	—	—	—	Aug.
30.	Uttar Pradesh	3	—	—	—	Nov.
31.	West Bengal	4229	—	1984	3	June
	TOTAL	16459	65	12156	31	

NA = Not available.
*Imported from Bihar.

are being carried out. Besides vaccines are supplied to the States/Union Territories on their demand.

CONCLUSIONS

The control of disease caused by vectors—haematophagous arthropods in rural areas is achieved by periodic spray of residual insecticides to interrupt transmission, by reducing the vector longevity and density. In urban areas the control methodology is based on elimination/treatment of breeding places with suitable larvicides for vector control with a view to achieve interruption in transmission.

These methods are supplemented by treatment of diseased persons with specific drugs. The control of vector-borne diseases is being integrated within the policy framework of health care delivery to the community through the Primary Health Care system. The system is not yet mature enough to undertake these activities. Further, in view of the development of insecticide resistance in vectors and the problem of environmental pollution due to extensive use of chemical insecticides/larvicides, other methods like integrated control measures with environmental engineering are being developed with a view to incorporate these methods in the public health programme.

ISSUES FOR CONSIDERATION

Promoting Community Participation

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INTRODUCTION

National governments are responsible for the delivery of human services such as drinking water supply, endemic disease control and primary education in most of the developing countries. The programmes to provide these services are designed and managed by career civil servants and financed from government revenues. Many of these programmes are successful in meeting the needs of middle-income residents of urban areas but few succeed in providing services to low-income people, especially those living in scattered rural communities. The failures are often due to the programmes' being unresponsive to local priorities and constraints, inadequately staffed and poorly supervised. These deficiencies result from the centralization of planning, execution and finance, and reflect the difficulties that inevitably confront centralized bureaucracies in producing commodities and services which must be adapted and used by diverse local consumers.

Decentralization would seem to offer at least a partial solution to the problems that have frustrated centralized government programmes. Community organizations would appear to offer the greatest promise. However, while private voluntary organizations have emerged in many parts of the world to deal with the needs of local communities they have remained minor forces in delivering human services. If communities are to assume a larger role in meeting their own collective needs, ways must be found to accelerate the development of local organizations, and to increase and then sustain their effectiveness.

The purpose of this paper then is to focus attention on the processes of community participation, and on opportunities for governments and other institutions to encourage and assist local groups in organizing to meet their own needs. The paper is divided into three parts. The first part examines the roles that local organizations might fulfill and the range of forms that local participation might assume. The second part considers community partici-

pation from the point of view of individual participants in order to highlight the forces that might be expected to affect cooperation and collective action. The third part outlines ways in which formal organizations such as governments, paragovernmental organizations and external assistance agencies might facilitate the formation and successful operation of local organizations.

ROLES FOR LOCAL ORGANIZATIONS

While most human needs are met by individuals and households pursuing their private interests, several critical needs require wider cooperation. Needs for food, clothing and shelter are typically satisfied either through the direct efforts of the individual (production of food for the family's consumption) or through the exchange of the family's services (labour) or products for services and products produced by other households, firms or public sector institutions. Production for own use requires almost no cooperation with others while exchange of services and products typically occurs through organized markets according to widely accepted rules for voluntary exchange. However, several important services can be provided at much lower cost if produced by a single institution; drinking water supply is an example. Control of the supply by this single institution affords it considerable power over both the quantities that are made available and the terms on which the services are offered to ultimate consumers. Unless this power is regulated, public interest may be compromised. In addition, a number of important services significantly affect people who may not have been included in choosing what to do or how to do it. For example, removing storm water from a neighbourhood necessarily benefits everyone even though only a handful of residents may have planned and carried out construction of the drains. Similarly, successful mosquito abatement programmes free entire communities of the pest; individuals acting in their own interests could not avoid benefitting their neighbours and thus may be discouraged from launching a spraying programme by both the scale of private costs and the inequitable sharing of benefits.

Activities that can be much more economically undertaken on a large scale or that impinge on the wider community are candidates for collective action. Formal government agencies have been established primarily in order to carry out such activities. Military defense, regulation of radio communications, and construction and maintenance of trunk roads are examples of functions which must be undertaken on a broad scale and which impinge on the well-being of entire communities. Local voluntary organizations also may address needs that cannot be effectively met through individual efforts.

Collective choice and action—community participation—may focus on any stage in the development of a programme and may at any stage contribute one or more of a range of inputs—information, analysis, decision making, distribution, accountability or economic resources. For example, community

members may be encouraged by a government agency to articulate their goals, to identify obstacles to the implementation of a proposal or to choose among a limited range of technically and economically feasible alternatives; the programme might then be designed, constructed, commissioned operated and financed by an agency of government. In such a situation, the function assigned to community participation is not only very limited, but the ferreting out of information, surfacing of conflicts and establishment of consensus are undertaken by the government agency. Whether or not the agency is successful in obtaining an accurate response and whether the community regards the outcome as desirable or acceptable will depend on how skillfully the agency works with the community. Success will also depend significantly on whether the community has developed accepted ways of expressing itself and of making collective decisions. This form of community participation requires only a single, time-limited effort by the community; its ability to remain organized or to deal with new and perhaps unexpected issues is not critical to success.

Communities may instead be asked to oversee and finance programmes established by agencies from outside the community. A critical weakness of programmes to provide human services has often been that their staffing and management has been indifferent. Higher levels of programme administration typically have been located in district towns or capital cities. Communications between local staff and the centralized administration have often been weak. The formal accountability of local staff for performance, therefore, has been limited. By instituting formal accountability at community level this problem might be overcome. However, in contrast with the previous example, this form of participation implies a continuing effort by the community. In addition, the participation of the community in the management of a scheme raises the possibility that as membership in the client group changes and experience accumulates, goals and constraints will also change, thereby, jeopardizing the original alliances that produced the organization, its rules, its leadership role and its priorities.

Spontaneous organization of a community by its members in order to plan, finance and administer programmes is a third form of community participation. It requires that people recognize a need, establish an organizational structure to meet that need, and recruit broad, voluntary membership. This form of community participation is often highly effective because it appears only in response to problems that a majority of the community recognizes as being serious.

Collective action, while confronting the problems of scale economies and spillover effects, raises its own problems. The groups of people who are subject to a problem, or likely to be affected by attempts to resolve it, are not likely to share identical perceptions of needs, priorities, and constraints. Thus, members will not generally agree on what is the best course of action.

Collective action implies that many (and perhaps all) of the membership must, in order to maintain cooperation, accept proposals which as individuals they regard as less than ideal. The success of collective action thus hinges on whether the individual participants remain convinced that participation on balance is worthwhile. That judgement in turn depends upon the group's capacity to identify issues, make choices, and allocate the sacrifices and gains from collective action. While the rules of market exchange are widely known and accepted, the rules for collective action are specific to the task at hand and must be developed, agreed upon and accepted as a part of establishing the group.

INCENTIVES TO PARTICIPATION

Community organizations are merely collections of individuals pursuing a shared objective. If organizations are to succeed, they must secure the acceptance of their role by the community, and they must attract a few people who will supply leadership and work to resolve conflicts. Thus, it is useful to examine the reason for a person to become involved in terms of the resulting costs and benefits to them and their families.

Involvement in a community organization imposes at least four kinds of costs on participants. First, joining an organization entails sacrificing individual freedom. In order to reap the benefits of collective action, the members of a group must subordinate their individual interests to those of the group as a whole. This is a sensible thing to do only as long as participation in the group yields benefits that outweigh the costs of this loss of personal freedom. Second, participation in a group requires that at least some of the members invest time in the organization's management. Priorities must be established, the implications of alternative courses of actions must be evaluated and the benefits and out-of-pocket costs of the effort must be distributed among the members. Third, individual participation, in most cases, requires an outlay of scarce resources. Beneficiaries/members are usually expected to contribute labour, materials or money to carry out the functions of the group. Finally, participation in a group carries with it the risk that collapse of the group will jeopardize the member's ability to meet his needs. A local organization may encounter unresolvable conflicts that destabilize the organization and thus cripple its effectiveness.

These sacrifices must be overshadowed by the benefits to individuals if they are voluntarily to become members or to maintain participation in a local organization. Successful local organizations have generally dealt with serious economic problems. The very long history of collective efforts to develop and maintain irrigation works in South and Southeast Asia is the most notable example. The frequently cited Anand Milk Producers' Union is another model of successful community organization. Few consumption-oriented local organizations have succeeded. Groups that distributed tangible benefits

in proportion to individuals' efforts are more attractive than those offering intangible benefits according to need or demand.

PROMOTION OF COMMUNITY PARTICIPATION BY EXTERNAL AGENCIES

Several means are available for sponsoring agencies to enhance the perceived net benefits of participation in local groups. The first is to increase popular awareness of the value of the benefits of a programme. Unhappily, most consumption-oriented development programmes respond to needs that are not yet clearly recognized by the target population. For example, preventive health care and improved sanitation are under-appreciated, especially by poor people.

The perceived benefits from participation can be enhanced through education, marketing campaigns and political action. Health and hygiene education have been widely promoted as a means of improving the use of health care, water supply and excreta disposal. These efforts probably should be viewed, in addition, as ways of enhancing perceptions of the benefits and thus mobilizing community support for programmes. Broad, public information/marketing efforts appear to be the most promising devices for increasing demand. For example, mass media might be used to enhance the image of piped water supplies or of improved latrines. Such efforts should first identify possible motives for adopting the improvement (status, health, privacy, aesthetics, etc.) and then stress the contribution of the innovation to meeting this "need" or group of "needs." In highly politicized societies, broad social and economic sanctions can often be mobilized by political authorities. The party can present issues in relationship to political ideology and thus give a reform greater legitimacy. In addition, it can often stigmatize political "deviance" in order to motivate socially desirable behaviour. Religious organizations have often been successful in using the incentives and penalties of the religion to increase participation.

A second broad strategy for promoting community organization is to reduce the costs, and risks, of participation. In small communities, the largest deterrent to collective efforts is usually fear of socially disruptive conflict. Community organizations must choose objectives, priorities and tactics, and must mobilize resources and distribute benefits. Each of these decisions and actions presents opportunities for conflict to emerge. If the group is to be effective, it must be able to surface and resolve conflicts before they become divisive and endanger the survival of the organization.

Conflict can be minimized by keeping organizations small, restricting membership to persons with harmonious objectives, defining objectives narrowly and distributing net benefits equitably. Large organizations are more susceptible to conflict than small ones simply because the larger number

of participants increases the diversity of objectives, expands the opportunities for disagreement over objectives and explodes the number of one-to-one comparisons of individuals' gains from the organization. In addition, large numbers complicate the process of conflict resolution by demanding that more information be amassed and greater numbers of people induced to accept the inevitable compromises. However, very large organizations may achieve an impersonal character similar to that of competitive markets and thus escape the need to resolve conflicts openly.

Establishing groups with homogenous membership is a second means of reducing conflict. If the participants in an organization share common problems and capacities for resolving them, then the likelihood is smaller that serious differences in priorities will emerge. Conflict is likely when the membership of a group includes people with grossly different incomes and wealth. Family status, sex, age and caste or tribe are also important sources of differences especially for groups providing social services. However, setting up groups with narrow memberships may create new elites by diminishing the ability of communities to resolve the problems of all their members. Since the early innovators are by definition the best qualified to perform organizational tasks, those who are not included will generally be left with the most difficult problems and the least effective leadership.

The third device for limiting conflict is to simplify goals as much as possible. Organizations with multiple objectives not only accumulate the conflicts peculiar to each objective but also raise problems of allocation of resources among the numerous objectives. For example, a dairy marketing cooperative that extends itself to offer family planning services jeopardizes its original successes by increasing the potential for conflict.

Finally, articulating organizational goals so that all members recognize the net benefits they are obtaining from the venture enhances the group's commitment to preserving it. Environmental improvements, in particular, often entail providing services to everyone in an area regardless of their perceived need or demand. Inclusion of unwilling participants then creates tensions that threaten the survival of the organization. This problem can be reduced by broadening the organization's objectives to include activities such that all participants perceive themselves as net beneficiaries. Water supply, drainage and sanitation might be undertaken by a single group, for example. However, as noted above, this strategy expands the scope for conflict and complicates the process of conflict resolution.

The processes that are employed in organizing the group and in carrying out its functions should be simple and acceptable. The options range from the individual acting alone in his own interests to community organizations with inclusive membership acting for the common good. The individual relies upon voluntary exchange to effect his goals and obtains all the benefits of his

choices. At the other extreme, collectivities must rely upon complex techniques of decision making and enforcement.

Community organizations must secure the broad support of their membership for any decision that is taken. This task is made more difficult by the fact that incentives are diluted by large numbers. The mechanisms for resolving differences include resorting to traditional, hierarchical authority (the African system of chiefs), negotiation and bargaining, and various forms of polyarchy. As the management task grows more complex, it becomes increasingly important that the technique of collective decision making be as simple as possible and that it command support of the membership. Introduction of formal (though inevitably arbitrary and imperfect) modes of organization and decision-making can reduce opportunities for conflict to appear. Identifying a satisfactory method for resolving conflict is perhaps the most difficult aspect of community participation since it must be determined for each setting.

External organizations can assist communities in forming workable organizations. Extension agents can be provided to aid in setting up meetings and in outlining the opportunities that will be afforded by collective efforts. Model byelaws and structures can be developed and supplied to local organizations. Formal organization is especially important if the group is expected to hold assets or conduct financial operations. Legislation can be enacted to give properly constituted local organizations legal authority to carry out specific functions. For example, the Philippines rural water supply programme has relied extensively on community-organized Local Water Authorities. Community participation sometimes may be incubated. Women's clubs, organizations of school children, and farmers groups may be encouraged in order to provide community members with experience in developing and operating local organizations. The Malawi rural water supply programme succeeded only after Government officials developed and operated a successful gravity water supply system.

Community participation, as discussed thus far, has referred to indigenous groups organized to deal with a community's needs. However, many functions require larger organizations either because the problem being addressed requires investments that exceed the community's financial resources, affects a number of communities, or requires resources that cannot be effectively employed at the community level. Major investments in transport, water supply or drainage, for example, typically must be financed from borrowings from financial markets and may require special provisions for supply of foreign exchange. Exploitation of water resources often affects down-stream users and hence should be planned with an awareness of the external consequences. Hospitals, machine shops, specialized physicians, highly skilled craftsmen and engineers are examples of specialized resources that often cannot be used effectively at the level of a neighbourhood or village and thus may need to be shared by several groups of users.

In order to deal with problems that require such inputs, a multi-level organizational structure is often needed. At community level, simple, routine functions may be carried out. Support and perhaps referral may be offered by more formal, professionalized organizations located in the regions. Planning, policy formulation and resource mobilization may be provided at the national level. Generally these support organizations are parts of the formal bureaucracy. The Indian three tier system for the operation and maintenance of village water supplies illustrates this notion. The community organization provides for recovering part of the costs of the system and operates and maintains the physical equipment. Assistance is provided by the formal bureaucracy in planning and executing works, procuring spare parts and supplies, and carrying out heavy maintenance. The national government sets targets for coverage and levels of services, offers policy guidance and mobilizes local and foreign resources.

CONCLUSIONS

This paper has argued that communities may participate in programmes of local interest in a wide variety of ways. However, in order to succeed, these groups must offer their members benefits which they value more than the costs to them of participating. Thus, community participation can be enhanced by activities that strengthen the members' perception of gains from the group and or by reducing the costs of involvement. Outside organizations can increase awareness of the nature and value of benefits and can reduce costs by assisting in the creation of local organizations offering technical assistance to the group and providing external inputs of cash, materials, or labour. Increasing the membership's skills in organizing and managing local organizations may also help to reduce internal conflicts and to increase the organization's effectiveness.

Issues for Consideration in Community Involvement for Disease Vector Control

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During the past half century the number of people at risk from tropical diseases in developing countries has increased. At the same time, difficult technical problems have arisen in disease control, notably vector and parasite resistance to insecticides and drugs which have been used as primary weapons to combat several vector-borne diseases[1]. In addition, due to frequent visits by health workers and spraying of the houses at routine intervals, people, too, appear to be becoming "resistant" to disease control measures, e.g., permitting spraymen to spray their houses every few months for years without end. At the same time, resources for sprays, drugs and other control components are becoming more scarce. For the above reasons, health planners and researchers have taken an interest in community participation in the hope that it will help to make disease control effective in the face of these constraints. This trend is reinforced by development planners who are emphasizing participation which encourages people to be more self-reliant.

Despite increased discussion, confusion surrounds the intent of community participation and even the basic concepts of community† and participation. In some situations, community participation is taken to mean a cheap source of

labour to assist government agencies in implementing programmes at the local level. In some cases, only information is provided and communities are expected to act alone without guidance about how to solve priority problems. It is now being recognized that community participation must mean the strengthening of people's participation in the health-related "political" process, broadly defined to include their involvement in planning, designing and implementing programmes in partnership with relevant agencies so as to respond effectively to community needs and priorities. In order to be so involved, people must be provided with appropriate information and, depending on the priority problems, with training.

A review of literature by Pitt indicates that, so far, little or no attention has been given to evaluation of the effectiveness of community participation for tropical disease control[3]. There is seldom a systematic examination of the potential of community participation at different stages in the disease control process or in different social and economic situations. Neither are there estimates of potential gains and costs to the community as a result of its participation in a control programme. Furthermore, to proceed most effectively, new methods for research in community participation are needed.

Communities and agencies need to consider together what is the appropriate role of the community in disease control programmes. In this paper issues are raised specifically concerning the control of vectors of tropical diseases: mosquitoes, flies, human-biting insects and snails. This is not meant to be an exhaustive review of vector control measures and the subject of community participation. Instead, discussions at previous meetings sponsored by the Vector Biology and Control Division of the World Health Organization and the Social and Economic Research component of the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases are drawn upon[1,2]. This paper aims to highlight issues that affect the feasibility of community participation for control of disease vectors and, thus, form the basis for analysing the issues of research subjects on this topic and guide decisions as to when and where additional research is needed.

COMMUNITY PARTICIPATION IN VECTOR CONTROL

The social goal of Health for All by the Year 2000 through primary health care has had significant impact on approaches to vector control. The

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† For example, communities have been defined on the basis of geographic location, ethnic groups, economic groups (e.g., migrant labourers), social categories, etc. One suggested working definition of community is "a group of people who are engaged in a relatively stable social relationship, usually in a local area"[2]. A specific definition of community is needed for each situation.

development of greater community and individual participation in vector control has only recently become a matter of widespread concern.

Whereas the primary health care programmes utilize institutions and personnel with direct support from the local and district levels, such programmes usually involve communities and groups in addition to dispensaries and health centres. It should be emphasized that such programmes must be effectively linked with a wide range of specialized technical and other services, including vector control. The supervision and evaluation activities will probably have to be entrusted to the relevant technical staff based at the provincial or national programmes.

An essential requirement for integrated vector control is the availability of more than one method of control and an adequate knowledge of the biology, ecology and behaviour of the vector, non-target organisms and facets of human behaviour, socio-economic constraints, and all aspects of human safety. For some vectors, a variety of control measures can be considered but, for others, there are only a few. For most vectors, sanitation, water and habitat management, waste management, source reduction and use of pesticides are the most important components of a vector control scheme.

Self has identified some concepts of primary health care which are particularly relevant to vector control[4].

(a) Using acceptable technology which the community can afford;
(b) Using appropriate education to develop the ability of communities to participate;
(c) Involving, in addition to the health sector, all related sectors;
(d) Identifying health activities the community can carry out.

Methods which are available have been identified in Table 1. While community participation has been discussed, recommended, debated and written about so often lately, one must remember that rural communities are greatly involved in cultivating "their plot of land and in solving the material problems of everyday life"[5]. Therefore, naturally, the part which they are expected to play in vector control must not be too demanding and must be compatible with carrying out the work on which their survival depends. Any participation which may be more demanding would not be continued and would be rapidly abandoned. Economic incentives may play a very important role here as was exemplified by Rajagopalan and Panicker[6] where algae removal from the back-waters in and around Pondicherry was considered an important measure for mosquito control since abundant growth of algae (*Entermorpha compressa* var. *pinqulata*) promoted mosquito breeding. It was found that this alga can be used as a raw material for the manufacture of paper and cardboard. Based on this, a small-scale paper manufacturing industry has been started and a cooperative society of fishermen has been formed for the removal and marketing of algae. This approach has a better chance of continued community participation.

Table 1. Vector control measures for individuals and community

Type of activity	Individual action	Community action
Reduction of man/ vector contact	(1) simple or insecticide impregnated mosquito nets (2) screening of houses/bedrooms (3) protective clothing to prevent mosquito bites (4) use of repellents to prevent mosquito bites (5) use of mosquito coils (6) use of water filters (specific to *Cyclops*) (7) improvement of dwellings by eliminating hiding places of vectors (specific to *Triatoma*)	(1) site selection of villages (2) deforestation and clearance of undergrowth near the villages and dwellings (specific to *An. balabacensis* and *An. nunez-tovari*) (3) vector deviation by siting of cattlesheds away from human dwellings (specific to zoophilic anophelines) (4) use of specifically designed traps (specific to tsetse traps for riverine tsetse flies) (5) closing of vents of septic tanks to prevent emergence of and oviposition by adults (specific to *Cx. quinquefasciatus*) (6) use of temephos in water, ponds, step wells, etc. (specific to *Cyclops*)
Destruction of adult mosquitoes and other vectors	(1) use of flit-gun or aerosol packs	(1) indoor residual spraying of chemical insecticides (2) thermal or cold fogging
Destruction of larvae	(1) emptying water containers periodically, scrubbing and cleaning where possible (specific to *Ae. aegypti*) (2) use of temephos sand granules for water containers (specific to *Ae. aegypti*) (3) refrain from throwing garbage into the drains and drain cleaning (specific to *Cx. quinquefasciatus*)	(1) larviciding (2) rearing and release of fish (3) flushing of drains and cleaning (4) removal of algae and other growth from the ponds
Source reduction and source alteration	(1) proper disposal of unused containers, tyres etc., (2) covering water containers (3) filling in breeding sites	(1) community clean-up campaign to remove trash and water-retaining debris (2) installation of proper latrines, drainage system and water supply (3) intermittent irrigation of ricefields (4) filling of vacant plots and pumping out of water (5) land reclamation

Simple source reduction methods along with the use of larvivorous fish through community effort have also been successfully used in Nadiad, Kheda district, Gujarat state, India, for control of malaria vectors. Here, the approach used was promotion of community awareness and involvement through health education. Another approach used here was inter-sectoral collaboration, e.g., with the forestry department.

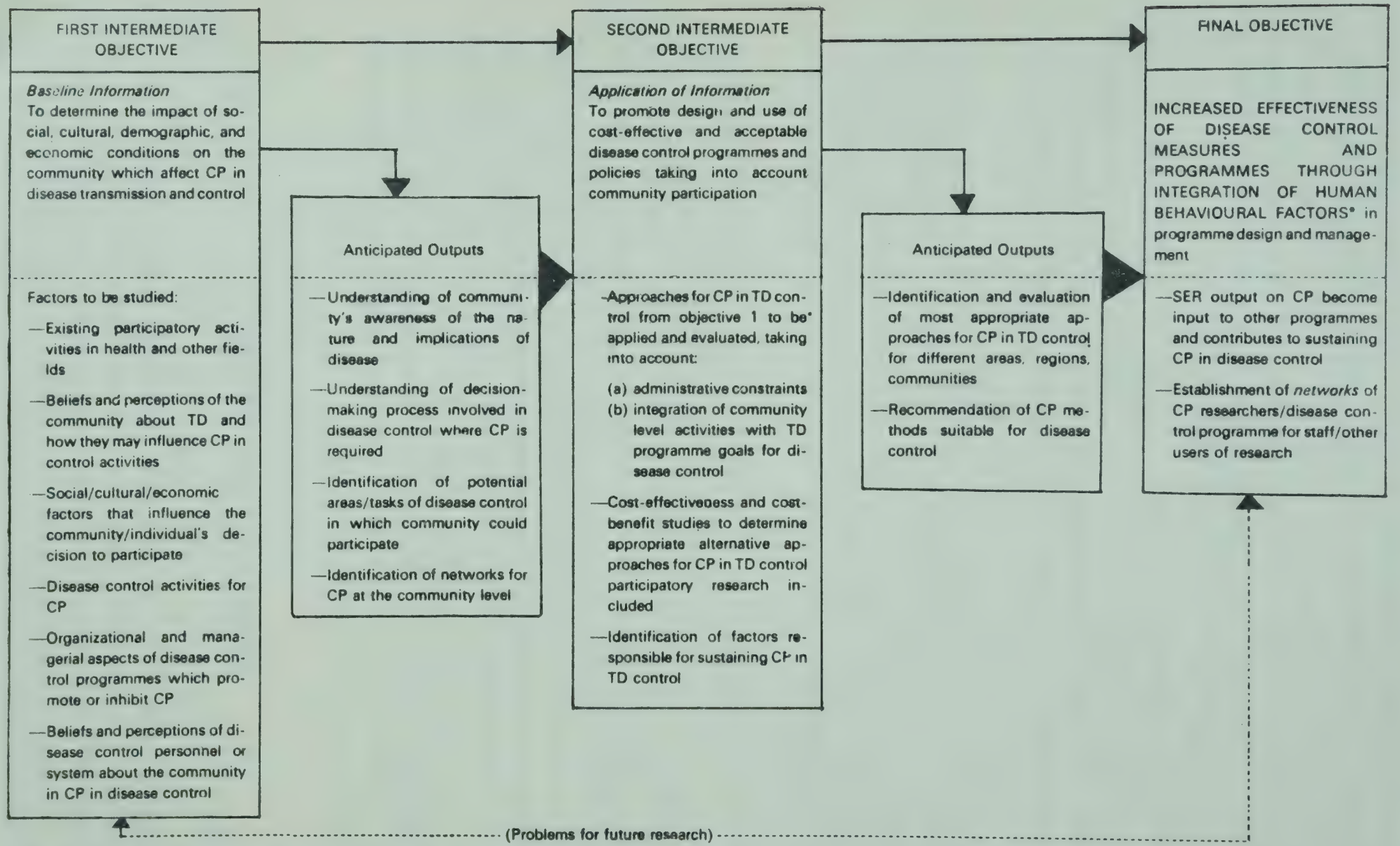
Community participation in *Aedes aegypti* control through group educational activities has been studied in Thailand[7]. Very high mosquito densities and difficulties in achieving high acceptance of the use of larvicides by inhabitants posed problems and further studies are being carried out.

Mosquito bed-nets impregnated with insecticides are now being evaluated in several locations (e.g., WPR, SEAR and AFR). A large-scale epidemiological evaluation is now underway in Gambia. This technique can be taught to the primary health care workers and the members of a community and, if successful, has good potential as a self-help method for prevention of mosquito-borne diseases.

It must also be remembered that there is no simple recipe for all the situations and problems. There are certain problems, for example, control of *Simulium* larvae breeding in the rapids formed by rivers where control work must still be organized through a vertically organized programme which depends primarily on the use of sophisticated technology for the aerial spraying of insecticides and/or biological control agents, which is a more cost-effective and practical measure. Thus, very thorough ecological and biological research is required for each situation. In addition, socio-economic considerations will also govern the suitability or otherwise of the measures recommended. Under many circumstances, vector control will still be feasible as a part of a strong vertically organized programme and, thus, social science research is also required on these points.

RESEARCH PRIORITIES

Based on the review of ongoing research, currently available disease control measures for the TDR diseases and research methods, the following main topics for research on the role of community participation in tropical disease control have been identified by the Fourth Meeting of the Scientific Working Group on Social and Economic Research[2]. The research priorities are grouped into three categories: analysing factors affecting community participation for disease vector control; evaluating the process of community participation; and evaluating the impact of community participation for disease and disease vector control. The aim of the research is to improve the effectiveness of disease control programmes.


FIRST INTERMEDIATE OBJECTIVE
Baseline Information
To determine the impact of social, cultural, demographic, and economic conditions on the community which affect CP in disease transmission and control
Factors to be studied:
—Existing participatory activities in health and other fields
—Beliefs and perceptions of the community about TD and how they may influence CP in control activities
—Social/cultural/economic factors that influence the community/individual's decision to participate
—Disease control activities for CP
—Organizational and managerial aspects of disease control programmes which promote or inhibit CP
—Beliefs and perceptions of disease control personnel or system about the community in CP in disease control
Anticipated Outputs
—Understanding of community's awareness of the nature and implications of disease
—Understanding of decision-making process involved in disease control where CP is required
—Identification of potential areas/tasks of disease control in which community could participate
—Identification of networks for CP at the community level
SECOND INTERMEDIATE OBJECTIVE
Application of Information
To promote design and use of cost-effective and acceptable disease control programmes and policies taking into account community participation
—Approaches for CP in TD control from objective 1 to be* applied and evaluated, taking into account:
(a) administrative constraints
(b) integration of community level activities with TD programme goals for disease control
—Cost-effectiveness and cost-benefit studies to determine appropriate alternative approaches for CP in TD control participatory research included
—Identification of factors responsible for sustaining CP in TD control
Anticipated Outputs
—Identification and evaluation of most appropriate approaches for CP in TD control for different areas, regions, communities
—Recommendation of CP methods suitable for disease control
FINAL OBJECTIVE
INCREASED EFFECTIVENESS OF DISEASE CONTROL MEASURES AND PROGRAMMES THROUGH INTEGRATION OF HUMAN BEHAVIOURAL FACTORS* in programme design and management
—SER output on CP become input to other programmes and contributes to sustaining CP in disease control
—Establishment of networks of CP researchers/disease control programme for staff/other users of research
(Problems for future research)

*Behaviour is defined to include social, cultural and economic factors.
Abbreviations: CP = community participation; TD = tropical diseases

Fig. 1: Research Plan on Community Participation in Tropical Disease Control as Recommended by the Fourth Meeting of the Scientific Working Group on Social and Economic Research in the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases (See Ref. 2)

Research on factors affecting community participation for disease vector control

A review of literature on past control programmes in the specific area of the research may give an insight into factors which facilitate or inhibit participation in disease vector control. For new programmes, systematic investigation of the structure and function of communities is needed to identify (a) existing community resources (special knowledge, skills, leadership, etc.) and (b) communication channels to the community and within the community in order to promote participation in disease control activities. Understanding the following additional factors could facilitate promotion of participation.

—The nature of the community and type of participation most useful for vector control, e.g., identification of target groups, those most at risk from the prevailing diseases and priority problems;
—How people use time to assess their availability for participating in vector control activities;
—Perceptions of health and disease so as to incorporate indigenous concepts of health and disease transmission into health education programmes;
—Local perceptions of costs and benefits of disease as they affect participation in disease vector control measures.

Analysis of these factors should enable determination of the most effective communication process for promoting community participation including (1) interactions between the community and members of disease vector control programmes, and (2) identification of local institutional structures that will sustain community participation over time.

EVALUATING THE PROCESS OF COMMUNITY PARTICIPATION

At the SWG meeting, a plan of research was developed to apply specifically to the subject of community participation in tropical disease control. The plan, as given in Fig. 1, is intended to guide investigators as they select areas for research and to enable funding priorities to be set. It should also provide the basis for evaluating research programmes in this area.

The evaluation of the process of community participation is particularly difficult. One main need is the development of process-related indicators of effectiveness. It is likely that use of the methodology of participatory research where the community members are involved from the beginning in the identification of the problem and design of improved conditions will contribute to increasing the participation of the community in vector control programmes.

A framework for the promotion of community participation might be developed to:

(a) Provide empirically testable statements about the process of participation;
(b) Identify the most effective ways of promoting and sustaining participation;
(c) Provide some predictability as to how to promote participation in new situations.

Evaluating the impact of community participation on disease and disease vector control

The efficiency and impact of vector control programmes with and without community participation should be evaluated. Such an evaluation will require identification and measurement of specific indicators of effectiveness in relationship to vector control and disease control. Such evaluations could include:

—Evaluating the effects of community participation on enhancing and prolonging the use of vector control strategies and their impact on health status by comparing such a programme with others having different types and degrees of community participation (including none);
—Comparing the cost and effectiveness of vector control programmes with different types and degrees of community participation (including none);
—Evaluate ways for integrating community-based vector control programmes with primary health care initiatives, and with other sectoral activities (e.g., agriculture, water supplies, income generating activities).

To increase the use of results from such research, so that the findings can contribute to practical actions, reports need to be submitted to and discussed with:

(a) The communities themselves;
(b) Vector control programme staff;
(c) Other relevant users.

CONCLUSIONS

There has been a gradual emphasis towards the community approach for solving vector-borne disease problems. Measures specific to the eco-epidemiological situation have to be tried and demonstrated. Difficulties of the total insecticidal system using a vertical approach have been recognized and several new and innovative methods are now available. Close collaboration between vector control scientists and social scientists has to be encouraged and maintained if long-term solutions are to be found. At this meeting the results of research efforts will be discussed and their usefulness for disease control will be assessed. It is anticipated that guidelines for future action will be developed and future research needs will be identified.

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Establishing a Framework for Management of Community Participation in Disease Vector Control

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INTRODUCTION

Although the idea of self-help has been around for a long time there is an awakening throughout the world that self-help is one of the most promising developments for poor rural and urban communities. Research is a necessary first step towards the goal of community participation for disease vector control. Many of the top-down solutions in vector control have failed or have become obsolete because of economical, logistical, social and other problems. Now the top-down strategy is beginning to shift towards building activities from the bottom-up and the key is local action. As a result, research will still be necessary if appropriate technology is to be developed and evaluated.

Many ministries of health are undergoing a period of rapid structural adjustment and their strategies are becoming more flexible. This change occurs because of shifting health priorities and economic necessity. One method of providing the necessary social change is through decentralization, where community and government interdependency can be demonstrated.

Rarely have ministries of health the necessary expertise in vector control because administrators are disease-oriented and are more apt to understand curative rather than preventive measures because of visibility of results. In the past, ministries tended to budget and plan on the short-term and as the significance of the problem lessened, the government input decreased. Long-range plans must replace the narrow short-term profit gathering concept in health, especially for the control of vector-borne disease with help from the communities.

Control of diseases transmitted by vectors involves environment, economy and human behaviour as well as vector and pathogen. This extremely complex relationship rarely suggests simple solutions. Vector control almost by definition means hard work over a long time at a continued expense. The evolution towards integrated control measures require a knowledge of many related ecological and biological aspects of the vector as well as socio-cultural factors within the community which extend beyond available expertise and technology. Furthermore, at the individual and community levels, it may take generations before the majority of people truly understand the cause-effect relationship between vector and disease. Therefore, at the initial stage, it may be difficult to demonstrate the influence a vector and its control will have on the quality of life which people seek.

As governments undertake a rethinking process in innovative approaches towards vector control, considerations must still be given to situations where a structured specialized programme against a disease or a vector could be more economical and efficient than the primary health care approach. Furthermore, communities may not be able to cope with emergency situations and central or regional governments will have to retain the capacity to react effectively in these situations.

Governments and communities must not expect miracles through community participation for disease vector control. Their actions may rarely equal the capability of the structured programme. Initially the level of control may actually deteriorate to a point of mass pessimism until such problems as found in management, training and motivation are resolved. This is a critical time for government and community where promotion, motivation and, in fact, all channels of communication must function rapidly and openly.

Two more factors must be considered during this initial period of project development. One is the possibility of overburdening the primary health care system. Vector control activities will be foreign to the workers and their priorities and work interest may be elsewhere. The other is that although pilot studies are necessary, they are usually biased through adequate budgets, supplies and staff as well as charismatic leadership and constant motivation. Furthermore, it is recognized that the extent and nature of community participation will vary between communities and countries as well as by the control methods selected.

PROGRAMME DEVELOPMENT

For any structural development to be successful, there must be an understanding of purpose. At each level, the degree of responsibility and achievement sought must be clearly defined and accepted. Each step towards the goal must be outlined clearly and concisely. This requires total commitment and effective management at each level for without organization, good intentions are worthless.

It may seem relatively simple to decide in principle on designation of who pays, participates, plans, leads and evaluates, but to put all of these considerations into practice is neither simple nor easy. At any level, involvement requires leadership, knowledge, motivation, communication, etc. and the number of actual true believers are few. Grass-roots vector control requires awareness of the need and a stimulus for action that must originate at the highest governmental level, at least initially. One effective approach may be through health education in schools and health promotion at the community level. A demonstration of effectiveness of an action by people from pilot villages visiting other villages or of individuals from the other villages having apprenticeships in pilot villages may be an appropriate method of promotion.

From both the technical and administrative point of view, it is folly for a government to attempt to satisfy all vector control demands. Ministries of health must establish realistic priorities about which vectors to control and about the most appropriate technologies to use. Only those vectors that fit into the framework of a government commitment should be selected. Many vector and pest problems can be handled in and around the home by individuals or families. Certain vector-borne diseases may best be resolved through drug treatment or immunization campaigns while others may require improved epidemiological surveillance with vector control occurring only during epidemics or to prevent their occurrence. In other words, there are many approaches to control vector-borne diseases.

An administrative structure is needed to permit the flow of information, supplies, equipment and so forth in all directions and to provide adequate expertise at referral levels. The shifting of the actual control of vectors to the community should not diminish the support or commitment of the other levels of government. Government agencies should become active partners by providing motivation, economic support, and the technical expertise required for supervision, evaluation and solving technical problems. Great care should be taken to ensure that any new vector control measure will not become too heavy a burden on the community and fail regardless of the potential benefits. An activity should be undertaken within the context of what can be realistically accomplished by the community.

One major aspect of programme development is an understanding that people are a fundamental national resource and their potential can be developed through education, motivation and action. To improve community participation, the government has to recognize that people can make decisions and the community must understand that responsibility follows an obligation of choice. Finally, to effectively solve problems, the concept of networking at all levels, especially at the peripheral, is essential since it enables people to communicate, the first step towards cooperation.

THE CORE GROUP CONCEPT

The feasibility of any control measure should be examined in relation to other alternatives, the ecology and size of the endemic area, the types of communities involved, their administrative and socio-political structure, and whether short or long-term control activities are required. Although planning activities may be done at the local level, the overall strategy for core group development and higher level decisions on national or regional plans of action should be a responsibility of the central level and should link communities with similar entomological, epidemiological and social conditions together.

This would imply that individuals approaching a community should be able to identify the control methods that would be appropriate to the local conditions and be acceptable to the community. As a result of these obligations, the concept of a core group of experts at the central level as well as regional levels, depending on the size of the country and the vector problems, has been proposed. The core group should be trained to advise communities on solutions to technical problems, to coordinate the activities at the various governmental levels and to create linkages at higher levels of government, universities, research institutions and international agencies. The core would provide facilities for ordering chemicals and equipment as well as handling the logistics of their distribution. It should have the responsibility and mechanism for gathering statistics and analysing data, including dissemination of this information through proper channels. Application of available technology for solving field problems should include a research capacity within the core group. The first step in creating a core group would be a clear definition of the needs, objectives and status of vector control within primary health care. The core group should contain more than entomologists because a single discipline will not have the interest or training to provide expertise in all areas associated with effective control of vector-borne disease. Once recruited, the core group should be trained as a unit taking both field and classroom together as a type of in-service training. Thus, the group would learn the basic aspects of other disciplines and recognize the needs and limitations of each. A team concept of working together should be developed that would lead towards more effective communication and action at all levels.

PROGRAMME EVALUATION

Community participation and integrated vector control produces challenges in programme monitoring, control, evaluation and disease surveillance as there will be a shift from the either/or approach towards vector control to a multiple option one. It will not be possible to weigh each variable, yet merely an improvement in the quality of life should not be sufficient to satisfy the overseers of the programme and its budget. Unfortunately, visible results in vector control have never been easy to demonstrate and may be more difficult

under new strategies. For example, entomological evaluation as recommended by an entomologist may not be acceptable or feasible within a community and epidemiological indicators may be too difficult to obtain within a primary health care system to provide effective disease surveillance.

Furthermore, integrated control may be associated with specific vectors acting within the context of space and time which would require a decision-taking capability beyond the community and lower referral levels. Any control evaluation is basically comparing present conditions with those of the past by surveys and observations. Within the context, the core group would be involved in either evaluation itself or in planning the appropriate methodology. A well designed evaluation should:

1. Verify relevance of the control action;
2. Assess if action is adequate;
3. Review progress made;
4. Assess effectiveness of measures employed;
5. Assess efficiency in terms of results and economics;
6. Assess impact of control action on community.
   —is it acceptable?
   —is it epidemiologically significant?
   —is it economically feasible to sustain our time?
   —do the people want to continue it?

It can be seen that the collection of this type of information will be difficult. To compensate for deficiency at all levels, will be in part the responsibility of the health promoter and educator. This intervention may be the key influence to motivate both individual and government to continue support of an action

PROGRAMME CONSTRAINTS

A community by doing several simple activities can reduce vector densities, reduce larval and adult habitats and prevent human-vector contacts. Even taken as a whole, these actions may not be sufficient to eliminate or even reduce disease transmission. Nevertheless, collectively they should increase the quality of life by reducing the number of bites a person receives and make any organized disease control effort more effective whenever its implementation is necessary. The success of control actions will be assessed in reference to their purpose. The vector control specialist may observe many defects in community oriented vector control and suggest improvements.

A major constraint will be community and individual motivation on a long-term basis. Consequently, any control measure should be built on a foundation of what a community is willing to do rather than what the primary health care worker or control specialist believes can be accomplished. A strong selling point for community action may be an incentive mechanism or income generating measure associated with the action.

In this context, the primary health care administrator and the public health epidemiologist must understand what can and cannot be achieved through community level vector control. In order to establish a programme these individuals must be convinced that the community has the capacity to implement intervention and, if implemented, acceptable health goals will be achieved.

Other important programme constraints are money and time which will be the communities input into the programme and neither will be plentiful. In fact, community participation without some perceived benefit may be a myth. Central and higher governmental levels will have to complement any community input. This will require some type of structured information flow, decision making, central purchasing, and transfer of funds to the peripheral level. The community, on the other hand, must accept the responsibility of being part of the process of arriving at a decision including contributing to its implementation and evaluation.

There are many technical constraints that can be demonstrated through pilot projects. It is here that the merit of pilot projects is demonstrated by seeking acceptable solutions. Even the less successful projects contribute to the goal of identification of solutions. A role of the core group will be in furnishing expertise for pilot projects.

There is an important global trend towards various types of individual and community self-help programmes. Vector control is only a minute part of the picture. At the same time vector control has evolved from a chemical approach to a holistic or comprehensive one leading to greater complexities in decision-making necessary for application of these appropriate technologies. The success of self-help in vector control will be determined by the quality and quantity of expertise at the more central levels as well as the individual's determination to improve his lot.

For these reasons, initial progress may be more pronounced at the level of personal protection than by group action. Effective intervention by the individual, be it by mosquito coils, bed-nets or source reduction, can be an educational tool for as it expands it may create sufficient peer pressure to produce the desired group action.

Migration into urban areas and other types of resettlement may cause new vector problems and the need for innovative vector control measures. India is facing this situation and has already recognized that urban and rural vector habitats and control measures may differ. At the same time, human behaviour is changing in both areas, but perhaps more drastically for the newcomer to the urban slum environment. One of the greatest challenges to achieve community involvement lies in harnessing the urban slum resident to recognize the advantages of accepting community responsibilities, without creating social discontentment or economic hardship. Vector control, such as simple environmental management through source reduction, may provide

the sociologist or anthropologist with a valuable method that might obviate adverse side effects.

Public services such as potable water dispersal, solid and liquid waste disposal and education are important complements to community oriented vector control. These services like vector control are searching for pathways of action into communities. The effectiveness of all public services will depend upon effective networking to produce more efficient collaboration.

Agriculture is changing rapidly as human population increases, demand for food will increase whereas the land and water available for food production will decrease. In considering this, linkages should be established immediately between the agriculturist (agronomist), medical entomologist and public health official, to study effective means to use this knowledge to develop environmentally sound land and water resource projects which will provide economic and health benefits to the community and promote further cooperation within and by the community.

CONCLUSIONS

There is great potential for vector control in primary health care through community participation. However, to be successful this will require commitment of funds, staff and materials at the central level. It requires structural adjustment and a generalist approach towards a definition of purpose. The government at each level, including the community, must organize and instruct each step towards the goal.

Communication is the route towards community involvement and education is an important stimulus to provide desire and motivation for community action. Selection of priorities to control a disease vector should be realistic and geared towards what is practical and possible as well as what people perceive to be in their interest. Since communities are not homogeneous, the goal is to enlighten individuals to encourage them to work towards a common cause.

The biology and ecology of vectors differ, as does the human and natural environment in which they exist. Conditions produced by nature and human behaviour frequently alter these factors making vector control extremely complex. Many technical problems in vector control will not stop by simply transferring control activities to a community. Consequently, community based vector control will still need a referral level technical group to plan, guide, research and supervise.

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Community-Based Integrated Vector Control—Techniques and Management for Countries of Southeast Asia Region

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INTRODUCTION

Malaria, filariasis, dengue fever, Japanese encephalitis, and leishmaniasis continue to be of public health importance in most of the tropical countries of the WHO Region for Southeast Asia. The prevention and control of these diseases, linked closely to various ecological factors, still depends mainly on anti-vector measures. Vector control service, research and operations, have been escalated especially since the end of World War II, where various control methods were developed and some were effectively used for over 30 years in national control programmes of vector-borne diseases. In recent years, many national vector control operations have been facing difficulties technically on account of the increased insecticide resistance in many vector species and operationally on higher cost of the alternative insecticides.

As an alternative, the benefit of integrated vector control approach has been widely recognized in this region and a variety of control methods/agents are available for use in "integration"[1]. In most member countries of the Region, however, this approach has so far been studied against selected priority vector species under different ecological conditions. Its applicability at an operational scale is yet to be seen, as this also requires vertical approach where highly trained technical and managerial staff are essential if available control methods are to be judiciously integrated in a cost effective manner.

In another development at the same time, Governments of the Member Countries not only experience many constraints in supporting vertical programmes for an indefinite period but also had the realization to provide an

extended health package to the rural masses. These compulsions led to the evolution of "Primary Health Care (PHC) System" by integration of more and more of vertical programme into a health service infrastructure with community participation as an integral part. The present communication tries to explain as to how community based integrated vector control programmes can be successfully launched under the primary health care system.

OPERATIONAL AND TECHNICAL PROBLEMS

In the region, most anti-vector operations have been carried out as an element of national or local control programme of vector-borne diseases, although recently there is a rapid increase in urban vector/household pest control by non-governmental agencies[2]. In the government operation, great emphasis has usually been laid on organization, system or strategy; and goals such as entity or reputation are usually considered to be of secondary importance, unlike in private business where success is totally based on "customer service". If government service is coverage-oriented, private enterprise is result-oriented. Very often, failures encountered in the control programmes are largely due to lack of operational and managerial skills rather than technical, especially ever since vertical programmes started to be integrated into the primary health care (PHC) infrastructure together with a decline in external resources. Today, many of the operational problems and constraints are difficult to deal with at a national level for a variety of reasons such as inadequate resources and/or lack of trained manpower[3]. Therefore, there is now a need for an organized system in which vector control can be economically carried out by nonspecialists. This would imply that vector control in future should be done, in the concept of self-reliance and as an alternative to dependency, as needed by the people and guided by the Government[4].

In the nine malarious countries of the region, anti-malaria vector control, as an example, is still based heavily on indoor residual sprays with insecticides, which in the past few years covered about 33.6% of the total population of one billion exposed to the risk of malaria[5]. Programmes for the control of mosquito vectors with the prolonged use of pesticides have encountered several problems: viz., (1) Technical; vector resistance to older insecticides (2) Financial; prohibitive cost of newer insecticides (3) Environmental; increased concern about environmental pollution by insecticides and (4) Operational; reduced acceptance by householders to have their houses sprayed with insecticides. There is, thus, an urgent need for alternative strategies of control.

INTEGRATED DISEASE VECTOR CONTROL

Rationale

Integrated disease vector control has been defined as "the utilization of all appropriate technological and management techniques to bring about an

effective degree of vector suppression in a cost-effective manner"[1]. Integrated means to form into a whole, to unite, to incorporate into a large unit[6]. It conveys the idea of a judicious meshing of parts into a whole but is not merely the use of several parts; the whole is greater than the sum of the parts. A combination of two or more methods is more complicated both operationally and technically as compared to a single method (Table 1) but is necessary and may provide the desired degree of control at a lower cost or with a greater long-term benefit. Though the concept was there for a long time, it has been neglected soon after DDT became the mainstay of the operational programmes.

A WHO Expert Committee[1] recommended that for most mosquito vectors, the following are suggested as the major components of integrated vector control schemes; (1) environmental management and source reduction by draining, channelling and land-filling, improvement of water margins and water level management, (2) personal protection by the use of bed-nets, repellents, etc., to reduce man-vector contact, (3) the use of insecticides as adulticides and larvicides, (4) the use of biological control agents (fish and microbial pathogens), and (5) health education and training. Many of these non-chemical methods were commonly used before the DDT era (Fig. 1).

Table 1. Comparison of major requirements between conventional single method approach and integrated community-based control of disease vectors

Information or activities required	Centralized single vertical approach	Decentralized community-based integrated approach
1. *Research/surveillance support*		
Vectorial status	some	most
Bionomics: habits and habitats	some	most
Ecology	very little	most
—Population/seasonal		
—Natural mortality factors		
—Ecosystem		
2. *Technology*		
Control agents	single	multiple
Control methods	simple	complicated*
Cost-effectiveness analysis	very little	essential
3. *Management*		
Resource management	some	much
Coordination	passive	active
Expertise	some	much
Supervision	some	much
Community motivation	very little	most
Health education	very little	most
Cost-benefit analysis	some	most

*manageable

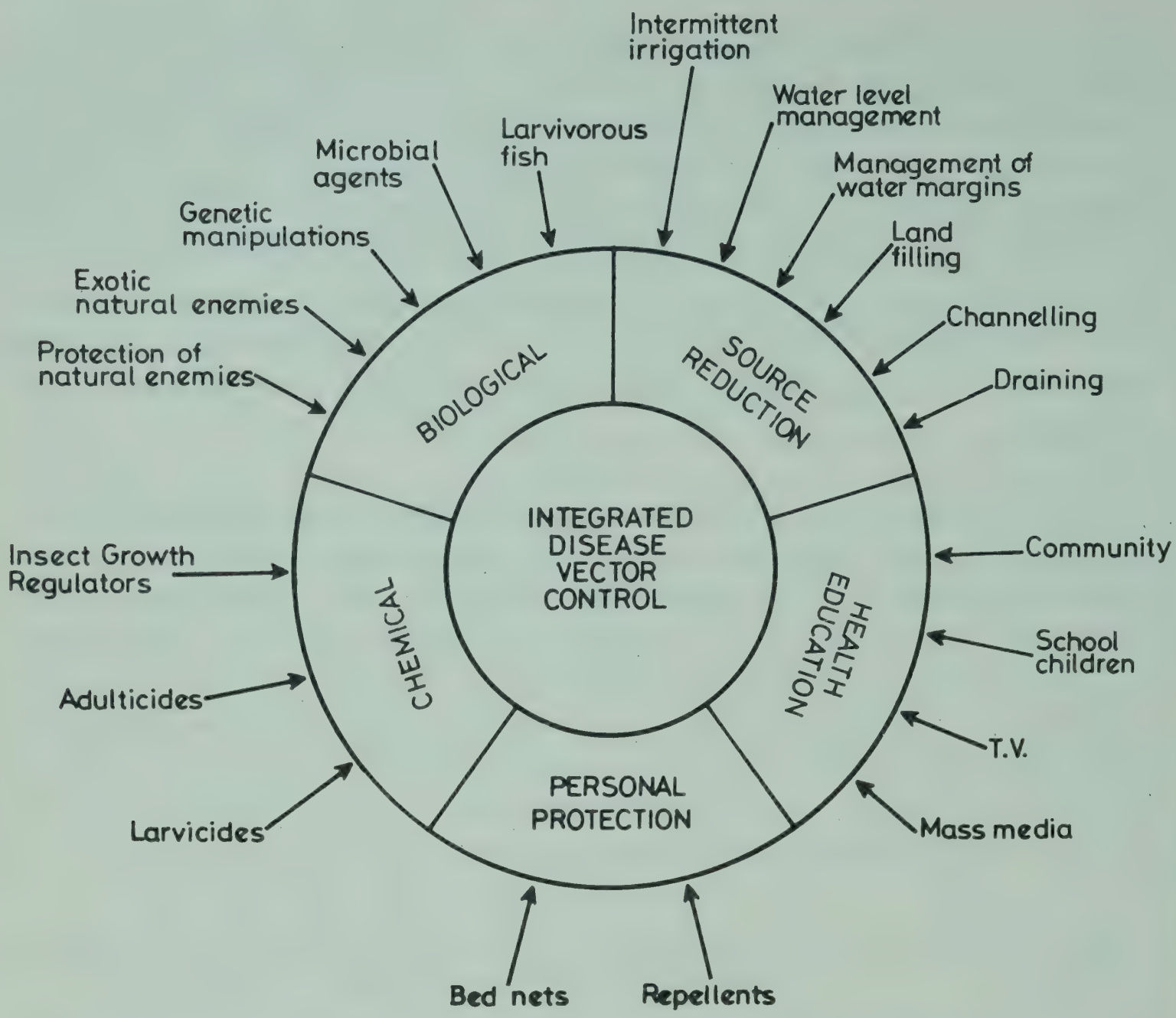

Fig. 1: Integration of various potential methods for control of disease vectors.

Priority

Priority areas for integrated disease vector control should be those situations in which adult vector control using the conventional approach is impractical for economic or operational reasons[1]. In practice, for the control of mosquito vectors, the integrated approach is most likely against larval stages with bio-environmental methods, in which the control programme can be simultaneously directed against vectors of several diseases[7]. For example, this could be done for malaria and filariasis vectors in many cities in India. Priority areas would need to be stratified into urban, peri-urban and rural communities and further sub-divided according to variations in ecology and/or endemicity.

The selection of priority target species depends on such local conditions as; (i) vectorial status, (ii) insecticide resistance, (iii) exophilic and exophagic behaviour, making indoor residual spraying inappropriate, (iv) vector breeding habitats restricted and well-defined, as in urban and semi-arid conditions. In the region, some important vectors amenable to this approach and being studied in demonstration projects are: *Ae. aegypti*, the vector of DF/DHF in domestic containers as being practiced in many localities of Indonesia (Suroso and Bang, personal communication); malaria vector, *A.*

stephensi in urban wells and reservoirs, *An. culicifacies* in irrigation canals and pools as being successfully controlled in Nadiad, India by the Malaria Research Centre (Sharma, personal communication), *An. sundaicus* in lagoons and swamps (Santiyo, personal communication); filariasis vector *C. quinquefasciatus* in polluted urban habitats, as has been demonstrated in the Filariasis Control Demonstration Project at Pondicherry, India[8].

DEVELOPMENT OF HEALTH DELIVERY SYSTEM IN SE ASIA REGION

Countries of the Southeast Asia Region are beset with many problems for providing adequate health care and in the absence of proper infrastructure they instituted vertical programmes supported by international and bilateral agencies. There was ample justification for these programmes. They brought down the prevalence of diseases to a reasonable level within a short time (malaria eradication programme) or achieved total eradication (smallpox), where technology, sources and epidemiology of the diseases matched well. However, in instances where the technology for control could not be applied on a wide scale or where external resources could not be ensured for indefinite periods, the rate of achievement tapered off or stopped due to multiple factors.

Vertical Programmes—Advantages and Disadvantages

Vertical programmes, as explained earlier, reduced morbidity and mortality caused by many priority communicable diseases. Besides this, the programme helped in; (i) development of existing national health services, (ii) establishment of higher standard of other health work, (iii) bringing out the need for statistical service, health intelligence and planning, and (iv) providing experience in health administration, logistics and manpower development.

On the other hand the vertical programme suffered from many drawbacks. These included; (i) absence of inter and intrasectoral coordination, (ii) concentration of programme in rural areas and overlooking of urban population, (iii) absence of balanced preventive and curative components, (iv) lack of support by people after initial stages and (v) it was expensive to be maintained for indefinite period.

Development of Primary Health Care concept

In the 1960's health planners weighing the disadvantages of vertical programmes and the need for integrated development of health services, considered the integration of vertical programmes into general health services. However, the health planners did not take into consideration the important aspect of community participation until the Alma Ata Declaration (1978) in which community participation has been considered a crucial component of Primary Health Care (PHC). This set the stage for development of PHC by integration of vertical programme.

The integration of activities for the control of communicable diseases with PHC services was considered advantageous to enhance the quality of preventive care, reduce morbidity and mortality due to communicable diseases and encourage the participation of people. The community will perceive the impact of control measures which would stimulate their active involvement in PHC—socially, culturally, managerially and technically. In course of time the community would become used to the additional load that would devolve on them with the broadening of the scope of integrated control of communicable diseases.

COMMUNITY PARTICIPATION

Introduction

Since community participation is the central consideration in the PHC approach[3], disease control programmes become part of this health care delivery system. Disease vector control forms a part of the element relating to prevention and control of local vector-borne endemic diseases. Since most of the countries of the Region have converted their time-limited vertical programmes, including malaria eradication, into long-term containment programmes, this strategy has brought about radical changes in objectives and flexibility in their approach which has made assimilation of the programmes into the PHC system much easier[1]. Similarly, other disease vector control programmes could be integrated at the PHC level as much as they are feasible operationally.

Role of the community

Involvement of the community for the success of any anti-vector programme assumes still greater significance as the problem revolves mostly around man and his environment[9]. In many vertical programme areas well-meaning and technically sound public health programmes have often been frustrated for lack of public support by the community. Such programmes are either inactively adopted or passively ignored, being viewed as imported external programmes belonging to the government. Consequently they deserve little, if any, community attention, action and response. Therefore, for the success of any vector control programme, individuals, families and the community have to be progressively involved, informed and educated. In urban areas, for example, the elected municipal councillors and heads of various political and social organizations are the important functionaries who exercise unlimited influence on the community in their respective localities, particularly in areas inhabited by socio-economically low population groups. For these supports, in almost all ongoing programmes it began with formation of a core or coordination committee, comprising of various heads of government agencies and leaders of local society. Public health officials are usually concerned with transmitting technical subjects of the programme to these functionaries, who can inspire individuals and families to participate

Table 2. Plan of action for the control of DF/DHF vectors in tropical Asia (Kalra and Bang, 1984)

Control methods	Expected agencies	Activities expected	Ways and means of approach
Source reduction	Community	1. remove/reduce nonessential water containers conducive to mosquito breeding 2. avoid/protect water containers from larval breeding	1. health education 2. mass media (radio, TV, films) 3. school children/housewives 4. volunteers 5. PHC workers 6. community leaders
	Government	1. disposal of refuse 2. provide reliable piped water 3. legislation 4. monitoring and assessment	1. set up a core working committee for inter- and intrasectoral coordination
Larval control	Community	1. larviciding 2. release of larvivorous fish	1. same as for source reduction
	Government	1. supply control materials (larvicides and fish) and equipment, as needed.	1. same as for source reduction

actively in the task of elimination of vector breeding in and around their houses. The government can provide these community leaders with the resources (chemicals, spray equipment, fish, etc.), and they can arrange for volunteers to accomplish the tasks when individual families cannot (Table 2).

Motivation

In motivation of community involvement in a local vector control programme, a prime question to be first answered is why community resources or involvement is required in spite of the fact that they have other very pressing priorities and very little time to spare for providing free labour. It has been realized that the success of any community-oriented health programme depends on a permanent commitment of the community, based totally on the interest of the people as in an income-generating community project[4]. In other words, the long-lasting involvement can be secured with "survival economy" rather than under such considerations as political priorities, technical concerns or national strategy. Consequently, the prime subject is not the concept of integration and the principle of the community involvement nor the control methodologies but the incentive for which they can be motivated. Very often the logical starting point for the motivation is to find out what, who and how the community-oriented project is intended to benefit. In source reduction campaign for the prevention of *Aedes* breeding in Central Java of Indonesia, knowledge (awareness) provided to school children was not reflected well in the attitude or practice as determined with *Aedes* surveys (Suroso, personal communication). There has to be a continued dialogue between the health personnel and the people, aimed at motivation of the attitudes of the community so that people may accept the control

1065
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programme as the "people's programme". This is of particular relevance because the problems revolve around man and his environment, and historically man has contributed to the breeding of important vector species. Health education, together with law enforcement provides strong support to source reduction as demonstrated successfully in Singapore[10].

CONTROL AGENTS AND METHODS (TECHNOLOGY)

Simpler method with inexpensive materials

Indoor residual spraying with DDT has proved to be the fastest, most simple, reliable and economical method for the control of malaria vectors especially in rural areas[11]. As insecticide resistance occurred in many vector species towards the end of the 1960s, many other insecticides and control agents have been tested in many localities and various research projects have been supported to identify and develop cost-effective control methods. In the Region, the number of control agents and methods, either developed or tested, are countless for use in anti-vector operation. However, so far not a single method which is any better than residual spraying of houses with DDT in malaria control has been established. In addition to its low price, DDT is one of the safest pesticides, since there were no adverse effects among the hundreds of thousands of spraymen engaged in DDT spraying during the past 25–30 years. In the Region except in Sri Lanka, DDT continued to be the insecticide of choice for malaria control, covering 85–90% of the total area, though DDT resistance has been reported from many localities. In India, against DDT-resistant *A. culicifacies* this insecticide is still the most cost effective agent in many plains Terai areas, due to high mortalities under "imposed exophily" resulting from excito-repellent effect of DDT[5].

Quick and low effective methods

In view of the limited resources and lack of skilled manpower, many national or local anti-vector operations usually aim at quick results but low effectiveness over a long period with simple and inexpensive methods. This is the prime reason why many other available effective agents and methods are not operationally utilized up to date. In Central Java of Indonesia, for example, residual spraying with fenitrothion is much more effective as compared to DDT but due to its high cost (about 30 times higher than DDT), DDT is still sprayed annually against DDT-resistant *An. aconitus* except in high malaria prevalent areas. *Bacillus thuringiensis* H-14 and a few insect growth inhibitors have been very effective against *Aedes* larvae in domestic water containers but so far they have never been operationally used in the field. Several larvivorous fish are also known to be effective in experiments but the impact is usually slow and its operational use requires high expertise. Likewise, owing to greater initial investment, many engineering methods commonly used prior to DDT could not receive much attention in spite of the fact that these would have resulted in long-term and auxiliary benefits.

Income-linked methods

In contrast to organized control programmes of urban vectors/household pests under professional management of control specialists, methodologies suitable and acceptable by community-executed projects are those which take minimum time and resources of the people and also provide auxiliary rewards. Experience has shown that any vector control programme, if linked with economic upliftment of people, finds ready acceptability even if it is of longer duration. Removal of algae for reduction of mosquito breeding linked with production of paper industry and better maintenance of backwater ponds to render them less suitable for mosquito breeding linked with prawn rearing adopted by the Vector Control Research Centre, Pondicherry are examples[8]. So is a programme which is of longer duration, employing local workers for carrying out the vector control operations, as needed commonly in source reduction for larval control. As the workers so employed will not only be beneficiaries of the programme, but will also have extra income, such an incentive can sustain the interest of the community in the disease vector control programme over a longer period. An experiment conducted by the Indian National Institute of Communicable Diseases rural filariasis control at Rajahmundry, is an example (Kalra, personal communication).

Vector control methods which are worth consideration for use by the community should meet the following criteria[4]; (i) the equipment, material and agents required to initiate and continue the programme should be readily available, (ii) the skills involved in the maintenance of vector control programmes should be such that can be easily acquired, (iii) the expenditure involved should not be too high for the community, (iv) the proposed approach should benefit other local enterprises, (v) the proposed approach should be without risk to the environment, (vi) there should be no unacceptable toxicity or other health hazards associated with the proposed measure, (vii) the proposed measure should be compatible with the local practices and attitudes, and (viii) the proposed technique should be well—tested, proved to be efficient, and should need only minimum evaluation from the community involved.

MANAGEMENT

Resource management

One of the weaknesses in most national anti-vector programmes is "underemployment" and an over-reliance on control agent(s) or method(s) whose impact is known to be operationally limited without institutional and organizational innovation. When an integrated vector control programme is to be carried out in the present concept of primary health care (PHC), the management process in the democratic approach would be more effective than in the bureaucratic because a close coordination is vital and necessary at all levels both within the programme and with outside agencies including the community.

Success of an integrated vector control programme, as conceived, would depend on effective application of multi-disciplinary methodologies. Here the principal problems are; (1) how to organize efficiently and delegate responsibilities, and (2) how to motivate and reward people as well as ensure the target. We are concerned with the management of people who control the vectors, as effective utilization of the control technology would depend mostly on personnel who put various control resources according to operational needs. Therefore, sound management, in most instances, is more important than the efficacy of each control technique. In a combination of two or more methods, if improperly done each method may interfere with each other[6].

Technical management

Since the objective of any integrated vector control programme is to reduce the main level of vector abundance below the risk threshold of disease transmission, full consideration should always be given to population dynamics being manipulated by natural mortality factors. This implies that an integrated vector control programme should be based on a sound knowledge of vector dynamics, natural mortality factors and risk level of local disease transmission.

Furthermore, unlike indoor residual sprays with DDT, integrated vector control cannot be possible without detailed field information on the ecology and bionomics of vectors, and their role in disease transmission, specifically; (i) the vector and its role in disease transmission, (ii) its geographical and seasonal abundance, (iii) its life cycle in terms of the development times of the various stages, (iv) its breeding sites, (v) the location where adults emerge, mate, feed, rest, hide and lay eggs, (vi) its host preference, feeding behaviour, and longevity, dispersal and migratory behaviour, and (vii) its life cycle in relation to the life and the habits of the people[1].

For the success of the integrated approach, the need of trained technical personnel in the field who are prepared to work with people in different disciplines cannot be overemphasized.

Cost management

Realizing that most of the vector-borne diseases are more prevalent in lower-income communities with poor hygienic environments, the control programme is usually directed against vectors of several diseases, as an integral part of local sanitation, for economic and operational reasons. Vitality of the programme is dependent on resource management in terms of inputs against outputs. In this management, the cost analysis may start to define clearly the problems in terms of the epidemiological needs versus the available resources[12]. For estimation of required input, it may be necessary; (i) to provide comprehensive technical planning and information on a continuous basis, (ii) to undertake monitoring and epidemiological investigations of refractory situations, (iii) to monitor operational impact, (iv)

to carry out applied field research to maintain operational flexibility, and (v) to undertake training at all levels. This cost benefit analysis would be most essential to determine whether or not a project should be undertaken in terms of the endemicity of the disease, the availability of control resources and interest of the affected community.

For economic and operational reasons, in any integrated approach, decision about which control methods or agents to use and to what extent they should be used, should incorporate the results of the appropriate analysis[1]. This analysis is usually considered a resource allocation technique. Cost-effectiveness analysis is to select the least costly method of achieving the project's objectives. The cost-effectiveness is the ratio of effectiveness of a control measure, a group of measures, or a programme as a whole, to its cost over a specific period of time. This means that the greater the effectiveness, the lower the cost, the more desirable will be the control method concerned. The degree and duration of effectiveness are important factors which can be measured by utilizing the methods and procedures adopted for evaluating health programmes.

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REVIEW OF RESEARCH RESULTS

Review of Integrated Control of Malaria in Kheda district, Gujarat, India

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INTRODUCTION

Under the National Malaria Eradication Programme (NMEP), the strategy of mosquito control in rural areas is intradomiciliary spraying of residual insecticides and in urban areas it is antilarval measures (mainly larviciding). There are nine vectors of malaria, of these *Anopheles culicifacies* is most widely distributed throughout rural India. The vector has been extensively incriminated during the last few years in parts of north India[1]. It has become resistant to DDT and HCH in most parts of the country, and to malathion in Gujarat and Maharashtra[2]. Therefore, failure of insecticidal spraying is mainly confined to control of rural malaria borne by *A. culicifacies.* In other vectors, the problem of control relates to either operational problems or exophilic and exophagic behaviour of the mosquitoes.

It is noteworthy to mention that after the implementation of the Modified Plan of Operation (MPO), the incidence of malaria has been reduced to about 2.2 million cases in 1985 as against 6.4 million in 1976. Unfortunately, for about 2 or 3 years now malaria cases have remained at about the same level. Focal studies have shown considerable increase in falciparum malaria in certain parts of north India[3,4,5]. The *P. falciparum* parasite has become resistant to chloroquine in many parts of the country, and alternate drug schedules have been implemented to curb the drug resistant foci[6,7].

The current strategy of intradomiciliary application of residual insecticides to interrupt malaria transmission is beset with many problems. Some of these are the ability of mosquitoes to evolve multiple resistance, yearly increase in the already high cost of insecticides and their application costs, misuse of insecticides, harmful effects of insecticides on the beneficial fauna and large-scale contamination of the environment. With this background, a radical change is needed in our strategy in order to bring about effective and lasting control of malaria. This refers to vector control by non-insecticidal methods such as source reduction, biological control and the use of minor engineering work to bring about semi-permanent or permanent changes in the local environment, thus making the areas non-conducive to malaria transmission.

Kheda experiment

An alternative to the use of chemical insecticides is the integrated control of malaria by the implementation of environmentally safe methods. In the Kheda experiment, the following methods of anti-vector and anti-parasitic control have been introduced with a view to study the economic feasibility of this approach to malaria control:

(i) Source reduction;
(ii) Minor engineering work;
(iii) Biological control;
(iv) Chemotherapy;
(v) Health education;
(vi) Community participation;
(vii) Environmental improvement by introducing village sanitation, social forestry and alternate energy sources.

The field study was aimed at; (i) demonstrating malaria control by non-insecticidal methods, and (ii) developing a cost effective model for use in other parts of the country.

Gujarat state is endemic for malaria. Of the 19 districts, Kheda is known for the highest incidence of malaria for several years, and in this district Nadiad taluka had the highest incidence of malaria. There was evidence of multiple insecticide resistance in *Anopheles culicifacies* and the people suffered from an extremely high incidence of malaria with occasional deaths due to falciparum malaria, although the areas were under regular spray with residual insecticides. Initial surveys showed that there were innumerable mosquito breeding sites such as temporary, semi-permanent and permanent ponds, seepage water, intradomestic breeding in various types of containers, drains, rivers, innumerable borrow pits and stagnant water in canals etc. The experimental villages are the villages of Nadiad taluka. Nadiad town is centrally located in the talukas, and is also the district headquarters. It is equidistant (55 kms) from Ahmedabad and Baroda on the Bombay highway. The study was initially launched in July 1983 in seven villages with a population of about 25,000 (designated as complex A). During 1983 sufficient

groundwork had already been done to monitor the impact of anti-larval and anti-parasitic measures beginning from January 1984. In September 1984 integrated control study was extended to another 14 villages (designated as complex B, population 34,000). In May 1985 the project was extended to cover the entire Nadiad taluka comprising of 100 villages (designated as complex C, population 3,50,000) as shown in Fig. 1. Monitoring of the impact in the entire taluka has started in January 1986.

A review of the work done under various components of the integrated control of malaria is briefly described below. A pictorial review is shown through Figs. 2 to 29.

(i) *Source reduction*

Elimination of all mosquito breeding sites was given priority. Small and medium sized water ponds were filled and levelled by simple earthwork. Drains were cleaned and water channelized into pits. Water from these pits was drained out on weekly basis. Soak pits are being constructed to absorb the water which otherwise flows on the streets. Surveys revealed that intradomestic breeding in discarded tins and pots etc., was an important source of breeding for the malaria vectors. All breeding in the containers inside houses is being destroyed routinely on weekly basis. During this operation, householders (more particularly women and children) are shown mosquito breeding in their houses and methods of its control. As a result, the villagers have become conscious of the possibility of mosquito breeding in their houses, and they have started to destroy the breeding themselves by turning the containers upside down to avoid water stagnation. In some water troughs which are used for drinking water by cattle, larvivorous fishes (Guppy) are being introduced. Intradomestic breeding was controlled in all the villages throughout the year. During 1985, mosquito breeding was controlled by source reduction in 7324 sites in complex A and 9114 sites in complex B villages. Study showed that in complex A villages 1,23,193 containers were checked and 5,196 were found positive (4.21%); whereas in the control village 45,286 were checked and 9,748 were found positive (21.52%). In complex B villages 1,57,469 containers were checked and 2,435 were found positive (1.5%) and in the control villages 19,451 containers were checked and 826 were found positive (4.2%). There was, therefore, a definite reduction in the mosquito breeding sites as a result of the control of intradomestic breeding.

It was estimated that there were at least 500–600 wells in Nadiad taluka. Most of these wells are disused and abandoned. A random check showed that these wells support moderate to heavy mosquito breeding. *Anopheles culicifacies* and *A. stephensi*, the two known vectors of malaria also breed in these wells. Breeding in all the wells has been terminated almost on permanent basis by the application of expanded polystyrene beads[8,9]. In some wells which are used occasionally Guppy fishes have been introduced.

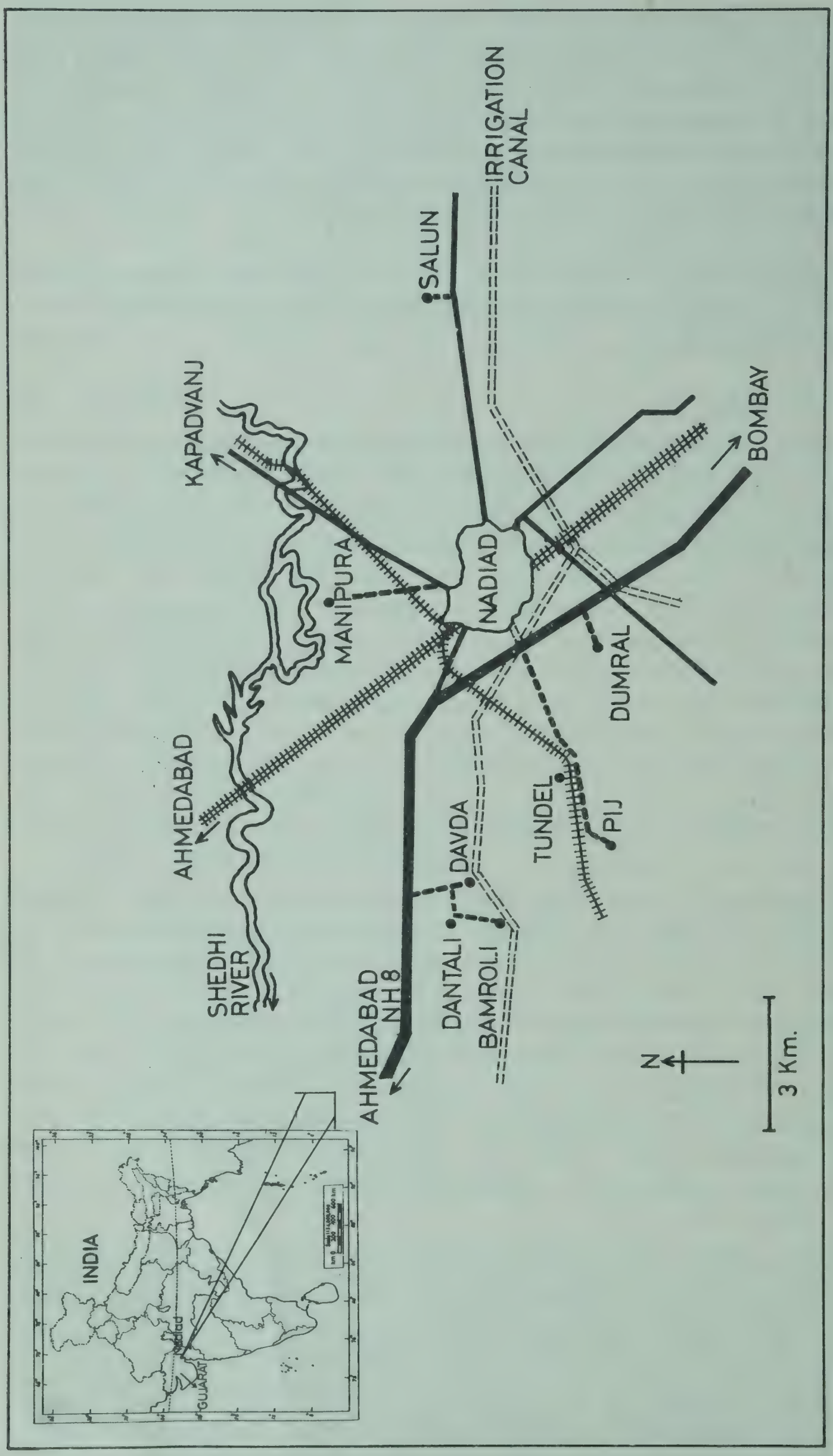

Fig. 1: Map of Nadiad taluka showing study area.

Health Education

Fig. 2: Demonstration of fishes eating the mosquito larvae.

Fig. 3: Demonstration of malaria parasite.

Health Education

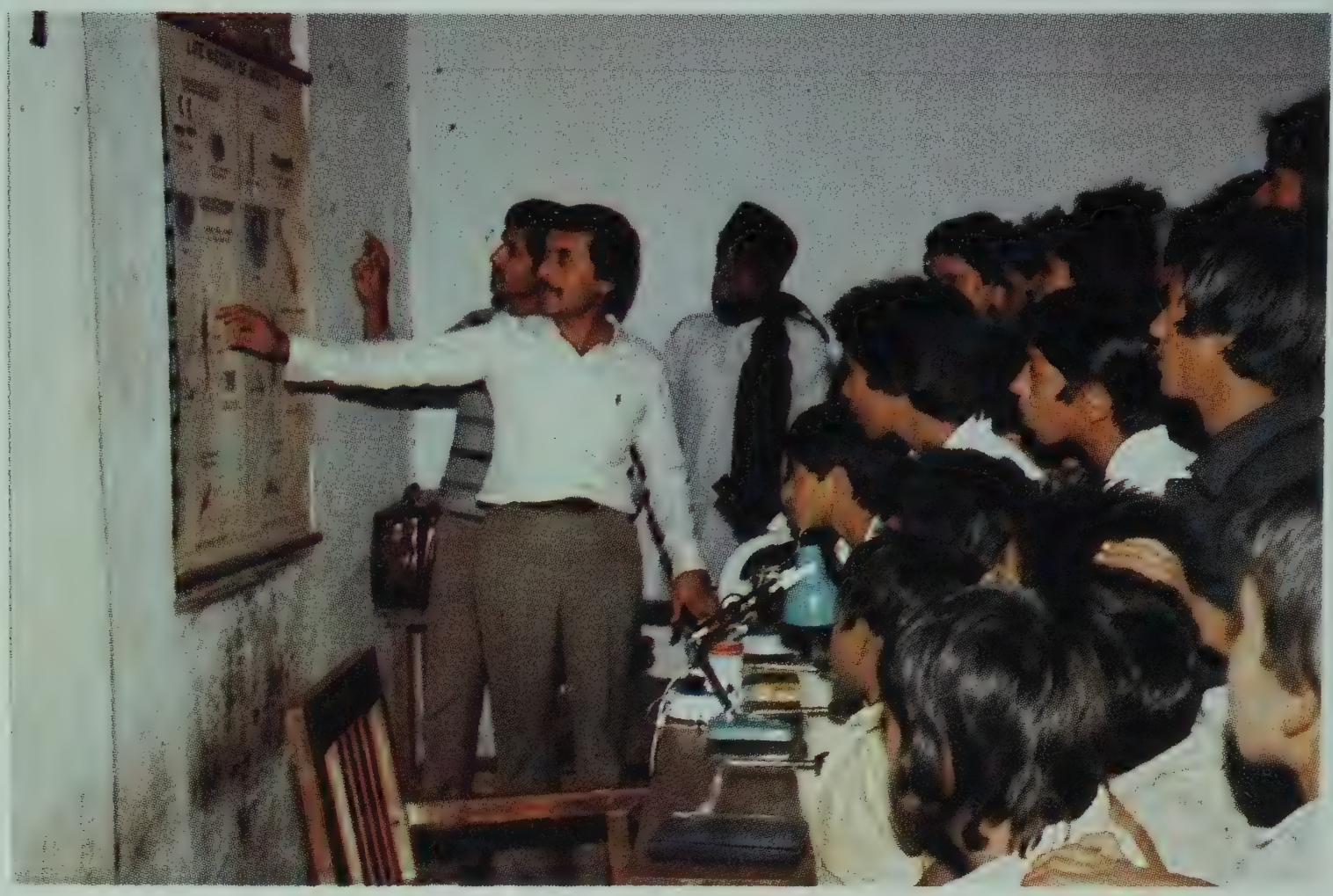

Fig. 4: Teaching the life cycle of mosquito.

Fig. 5: Visitors to the biological control laboratory.

Community Participation

Fig. 6: Women participating in plantation.

Fig. 7: Villagers participating in cleaning of pond.

Community Participation

Fig. 8: An abandoned pond being converted to hatchery.

Fig. 9: Earth work by village youths.

Source Reduction

Fig. 10: Source reduction by earth work.

Fig. 11: Seepage ditches eliminated by earth work.

Source Reduction

Fig. 12: Borrow pits levelled with earth work.

Fig. 13: Eliminating borrow pits by simple earth work.

Source Reduction

Fig. 14: Before earth work.

Fig. 15: After earth work.

Source Reduction

Fig. 16: Before earth work.

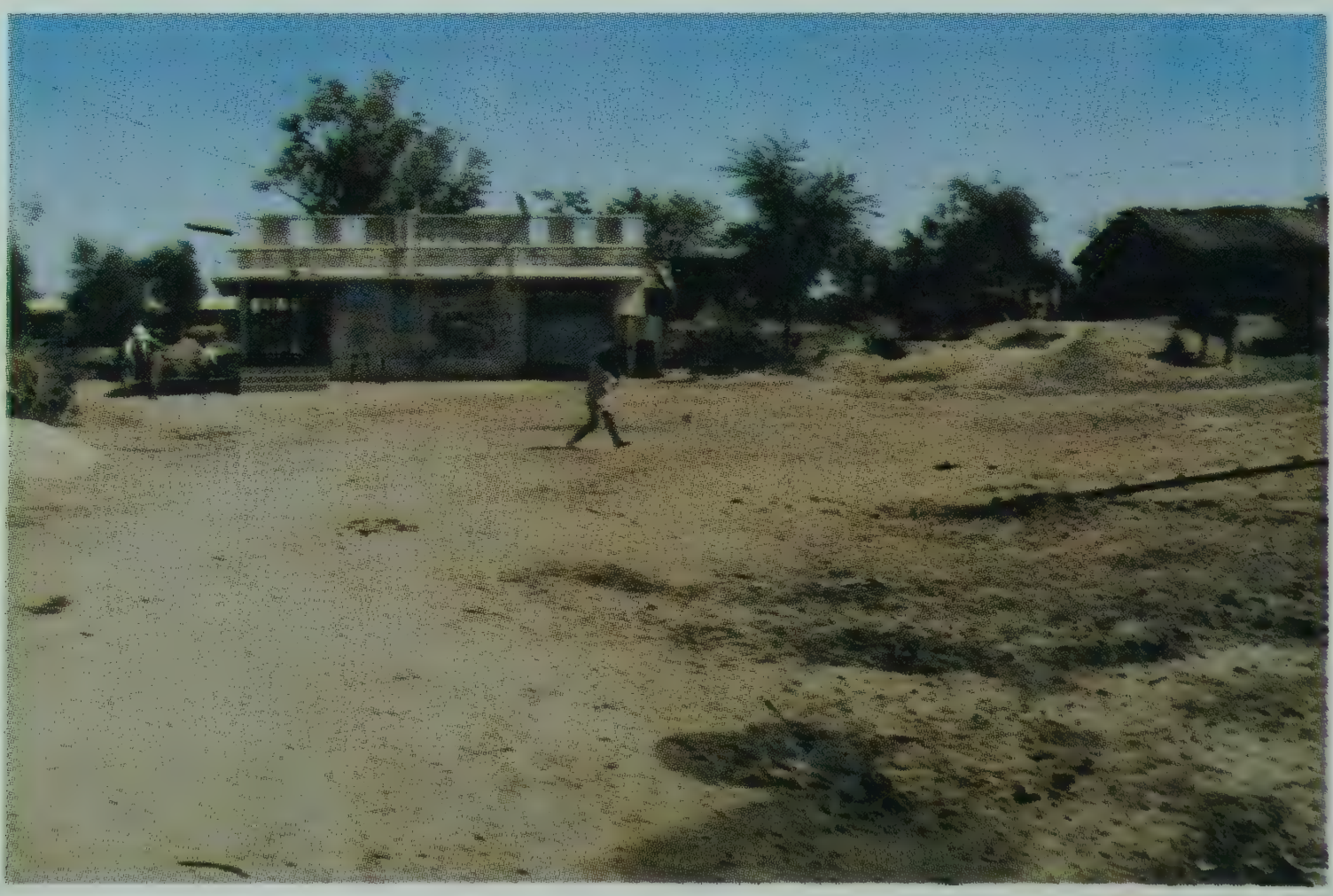

Fig.17: After earth work.

Source Reduction

Fig. 18: Before earth work.

Fig. 19: After earth work.

Mosquito Breeding Sites

Fig. 20: Intradomestic breeding containers.

Fig. 21: Street with waste water.

Mosquito Breeding Sites

Fig. 22: Canal without flowing water.

Fig. 23: A pond infested with water hyacinth.

Mosquito Breeding Sites

Fig. 24: Running water from the taps.

Fig. 25: Rice field.

Fish Production

Fig. 26: Water hyacinth being removed for growing edible fishes.

Fig. 27: Big permanent pond converted for growing carp and prawns etc.

Biological Control

Fig. 28: Guppy fishes are being introduced (see the clean margins of the pond).

Surveillance

Fig. 29: Surveillance worker collecting blood smear from a fever case.

(ii) *Minor engineering work*

Most of the villages have piped water supply. Leaking pipes, taps and discharge of water from the tube-wells were commonly encountered in the villages. All leaking pipes and taps have been repaired and are being maintained. Borrow pits etc., are levelled with earthwork. A recent introduction is that of soak pits. These are being encouraged to eliminate flowing water on the streets. Till December 1985, 78 soak pits were constructed in six villages. There are also many pits/depressions inside the village and agricultural fields, and in these sites water stagnates during the rainy season and supports mosquito breeding. All these areas are being levelled by earthwork thus eliminating the breeding sites. Many seepage sites which are preferred places for mosquito breeding were filled with earth. During 1985, 876 trolleys of soil in complex A and 900 trolleys of soil in complex B villages were transported in 13 villages for levelling pits and depressions.

(iii) *Biological control*

Initial fish fauna surveys were carried out in all the water bodies in the experimental areas. Identification of the indigenous fishes revealed that there were 21 types of fishes in the study villages. Laboratory tests showed that at least 14 species were larvivorous. Local fish fauna also consisted of the two well-known larvivorous fishes, i.e., Guppy and *Aplocheilus*. Guppy fishes are being mass-produced in hatcheries maintained by the Centre. Almost all hatcheries in the villages were made in ponds and abandoned cement tanks. It was estimated that hatcheries established in seven villages were enough to supply Guppies to another group of 20 to 25 villages. Since most of the fishes are larvivorous and there were Guppy and *Aplocheilus* in the ponds, it was difficult to explain the presence of mosquito larvae in almost all ponds. During discussions with the villagers and fishermen it was revealed that these ponds were being auctioned for fishing and the fishermen were collecting even the spawn and fries with the help of fine mesh nets, thus depleting the ponds of all the developmental stages of the fishes. These ponds in turn supported heavy mosquito breeding on the margins. As a result of health education it has now been agreed that fishing nets would be at least of 2.5 to 3 cm^2 size mesh. In addition to this, margins of the ponds are cleaned on routine basis. Guppy and *Aplocheilus* fishes are now found in all ponds and there is no mosquito breeding in the ponds. Introduction of Guppy fishes is a continuing process. During 1984–85 a total of 4.27 million Guppies and *Aplocheilus* fishes were introduced in Nadiad villages.

(iv) *Chemotherapy*

Malaria surveillance is carried out on weekly basis through a worker who lives in the same village. All slides are transported to the laboratory on the same day and treatment to the parasite positive cases is started within 24 hours. No parasite positive case is allowed to go without radical treatment.

Malaria treatment is carried out as per the NMEP's drug policy[2] except *P. falciparum* cases which are given 1500 mg chloroquine, adult dose. Prompt treatment of all malaria cases is of great help in reducing parasite load from the community.

(v) *Health education*

Brief talks, demonstrations and visits of the villagers to the research laboratories are a continuing activity and have brought awareness to the community. The demonstrations include: fishes eating the mosquito larvae, malaria parasite in the red blood cells under the microscope, mosquitoes and their developmental stages and methods of protection from malaria. During 1985, a total of 93 demonstrations were held in the experimental villages and an estimated number of 18,000 villagers attended these demonstrations. Brief talks in schools and panchayats on the biology of mosquitoes, methods of malaria and mosquito control, how malaria is transmitted, what to do in case of fever, and how one can help control mosquito breeding are very useful in soliciting help of the villagers in vector control activities. As a result of these demonstrations and talks, the enthusiasm of the villagers for our activities was initiated and their participation in all our activities increased manifold. During 1985, 517 visitors from 38 villages visited the laboratory to familiarize themselves with the research activities of the field station.

(vi) *Community participation*

When the study was initially launched, staff of the Centre was given indifferent treatment in almost all the villages. Often, it was difficult to talk to people, and those who did respond showed little interest. In spite of this indifference, work continued in the villages with full enthusiasm, particularly with respect to demonstrations, health education and treatment of malaria cases. Participation of the Centre in village activities, although unrelated to our objectives; such as any function or meeting etc., proved very useful in changing the attitude of the villagers. During this period of indifference, prompt detection and treatment of malaria cases infused confidence in the villagers, and our acceptance in the village communities started to increase at a steady pace. The first change was seen in the educated classes who knew more about the activities of the Centre and the serious problem of malaria. This was reflected by the desire to call panchayat meetings and discuss the activities of the MRC. During these meetings the decision to help the MRC staff in vector control was taken almost spontaneously. This followed a gradual closer interaction with almost all age groups of the village community. Women were in particular interested in cleanliness and in obtaining treatment for themselves and their children, and they invariably came forward for blood tests on their own.

Health education lectures were the turning point in motivating people. The villagers were advised to keep their surroundings clean and empty pits at least once a week. Women and children helped in the control of intradomestic

breeding by making sure that no pot or discarded tin was left in their houses with stagnant water. Whenever some mosquito breeding was found inside the houses, owners were generally unaware of it and they invariably regretted the lapse. Over a period of time there was such a deep impact of our activities that MRC's work became a common point of discussion in the villages and MRC became a household name. All staff, equipment, vehicles etc., became symbols of malaria control by environmental sanitation. In the first year itself a proposal made by the MRC to village youths *Yuvak Mandal* to clean the dumping ground and convert it into a playground was accepted as a challenge and young boys came out in large numbers to clear the dumping ground and made it into a beautiful cricket field. Similarly, many young men helped the scientific staff in cleaning the hyacinth infested ponds, introduction of larvivorous fishes, earthwork and many other routine activities.

Still every village needed a lot of earthwork to fill the borrow pits and other depressions etc. MRC had no resources for such massive development work which was possible only with the help of community participation. As an experiment we hired a tractor with trolley and started to do the earthwork by hiring daily wage workers. This gave an insight to the villagers of what could be achieved by simple earthwork. Since labour was quite expensive, it was suggested that the villagers come forward for participation in the field work. The village panchayats do not have a tractor and, therefore, a second breakthrough was unlikely to come unless this facility was available to them. We, therefore, bought a tractor and a trolley. The tractor with driver and petrol is made available without charge to the villagers provided they do the earthwork as per our advice. The expenditure on labour is incurred by the village panchayats. This turned out to be a very attractive proposal and demand for the tractor started to increase. We had to buy another tractor, and now there is at least four weeks of booking for each tractor. The purpose of demonstrating the usefulness of earthwork was most adequately served. The village community can see the advantage of their own work, and they do not need any more health education or any other kind of persuasion.

An excellent example of our acceptance in the villages comes from the fact that some people in the villages were very busy in their own work and were not participating in the programme. A large number of such people have made cash donations for vector control work. During 1985, cash donations made by the individuals, milk cooperatives and other agencies were Rs. 24592 for the intervention work. Money is handled by the panchayats and donations are used to hire daily wage workers. This spontaneous response of people has become an interesting feature of community participation, and reflects the tempo of the people.

During this period confidence of the villagers in the activities of the MRC increased so much that they were willing to agree to almost any proposal. This was reflected by the fact that when other agencies wanted to introduce their own programmes, they sought MRC's help. Advantage of this goodwill was

taken in the introduction of a social forestry programme. Social forestry was introduced mainly with the objective of; (i) planting saplings that have high water requirement like *Eucalyptus* thereby converting the marshy areas into dry land and eliminating an important source of mosquito breeding, and (ii) making profitable use of the waste land. The income generated from social forestry would go into strengthening panchayats and would in turn be used in village sanitation. The villagers were informed of this proposal through discussions, and in the next few weeks, the office was flooded with requests for saplings from individuals and panchayats. The villagers were advised to dig their own pits for planting, and attend to the plantations afterwards.

Occasionally *Shram Dan* or free labour is organized. Men, women and children come out to work in the village. *Shram Dan* has been very helpful in development work which otherwise would have taken a long time. These activities were very useful in converting our work into a movement which was the key to success.

The villagers were also shown the advantage of soak pits. Know-how was provided to those who were willing to have their own soak pits. Villages with soak pits have no stagnant or running water on the streets.

Mosquito breeding in ponds generally takes place in shallow water on the grassy margins. These margins are cleaned routinely enabling fish to survive better, thus eliminating mosquito breeding in the ponds. Besides these activities efforts continued to convert these ponds for profitable use. Experiments in the laboratory and outdoor ponds showed that Guppy, common carp, major carp (Rohu, Katla and Mrigal) and prawns are compatible and can be grown together. Ponds which were a source of mosquito breeding could, therefore, be converted for the production of food fishes, prawns and at the same time mosquito breeding could be eliminated. The villagers were informed of this proposal which was immediately accepted. The village panchayats have passed a resolution giving eight ponds (1 to 3 hectares each) to MRC on five year lease without any conditions or payment. These ponds are now being experimented on for optimizing fish production. The ponds were cleaned and 2,25,560 fries and 10,250 fingerlings of major carp and 40,000 juvenile prawns were introduced. These fish are developing extremely well and these otherwise abandoned ponds are expected to provide a net return of about Rs. 2 to 3 lakhs in one year.

The institution of panchayat has been very useful in mobilizing people and eliciting their wholehearted support and cooperation. The panchayats have also contributed to these developments by organizing group discussions and *Shram Dan*, providing tools for earthwork, storage space, allowing easy access to houses and making cash donations.

(vii) *Environmental improvement*

A social forestry scheme has been introduced in the experimental villages with the aim to plant trees such as *Eucalyptus* to dry the marshy areas and

other trees in the waste land to provide wood and other forest products. Besides trees are known to improve the environment and enrich the ecology of the region. In 1984, 70,000 and in 1985, 1,14,000 trees were planted. The demand for trees has increased manifold. A compilation of demands from the individuals and panchayats showed that in 1986, five million trees would be required for Nadiad taluka. A few other schemes for community latrines, biogas plants, fuel-efficient stoves and solar energy sources are being worked out for introduction in the villages.

Impact assessment

Monitoring of mosquito density and malaria cases has continued on weekly basis. The average man hour density of anophelines in 21 experimental and three control villages is shown in Fig. 30. There was significant reduction in the densities of all anophelines in the experimental villages for the entire duration of 1985. Highest densities were found in cattlesheds foilowed by mixed dwellings and the lowest densities were found in the human dwellings. The densities of *A. culicifacies* in human dwellings were almost negligible in the experimental villages. Monitoring of intradomestic breeding also showed great reduction in experimental villages in complex A and B as shown in Table 1.

As a result of integrated control there has been a drastic reduction in the incidence of malaria in complex A and complex B villages as shown in Tables

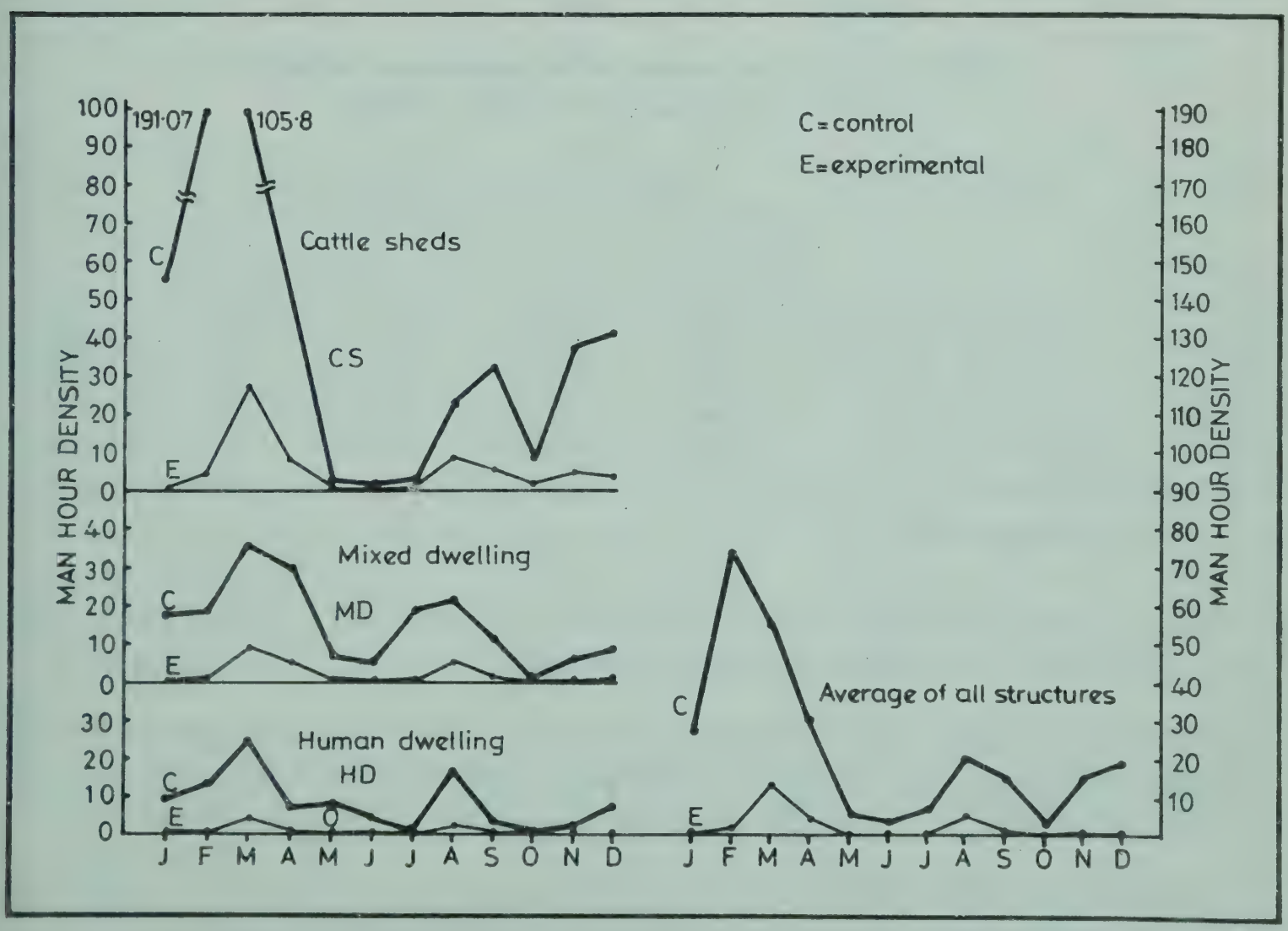

Fig. 30: Man hour density of *A. culicifacies* in experimental (average of 21 villages) and control (average of 3 villages) villages in Nadiad Taluka (1985).

Table 1. Results of intradomestic breeding (1985)

Villages	Sites checked			
	Nos.	Positive	%	Range
A				
Experimental	123193	5196	4.2	(2.97–7.54)
Control	45286	9748	21.5	(9.85–35.74)
B				
Experimental	157469	2435	1.5	(0.49–5.3)
Control	19451	826	4.2	(0.81–11.2)

Table 2. Incidence of malaria in the experimental villages (Complex A-7 villages: Population 26,000)

Year	History of spray	Quarterly record of malaria cases				Total
		Jan.–Mar.	Apr.–Jun.	Jul.–Sep.	Oct.–Dec.	
1981	HCH/Mal. sprayed	374	955	914	1797	4040
1982	HCH/Mal. sprayed	982	849	417	107	2355
1983	DDT sprayed	64	75	187	85	411
1984	Integrated control (without spraying)	26	36	61	18	141
1985	-do-	6	8	44	10	68

Table 3. Incidence of malaria in the experimental villages (Complex B-14 villages: Population 34,000)

Year	History of spray	Quarterly record of malaria cases				Total
		Jan.–Mar.	Apr.–Jun.	Jul.–Sep.	Oct.–Dec.	
1981	HCH/Mal. sprayed	214	586	754	477	2031
1982	HCH/Mal. sprayed	396	908	549	115	1968
1983	DDT sprayed	86	149	185	52	472
1984	DDT sprayed	17	33	72	21	143
1985	Integrated control (without spraying)	4	29	48	5	86

2 and 3. It may be noted that the incidence of malaria remained extremely high even when the villages were sprayed with DDT/HCH or malathion.

Results have been very encouraging so far and the study is being extended to Nadiad urban area. It would be extended gradually to cover the entire district of Kheda as per the time-table of activities shown in (Table 4).

The method is cost effective. The cost of integrated control of malaria in Nadiad taluka is Rs. 12 to 14 lakhs respectively with DDT and HCH. With integrated control it is Rs. 18 lakhs which is about 35% of the cost required to

Table 4. Integrated control of malaria in Kheda district—time table of activities

Phasing	Target Population	Preparation	Control	Maintenance/ Development
	Phase 1			
Demonstration	25,000 (7 Villages)	Jul.–Dec. 83	Jan.–Dec. 84	Jan. 85 onwards
	60,000 (21 Villages)	Jul.–Dec. 84	Jan.–Dec. 85	Jan. 86 onwards
	3,50,000 (100 Villages)	Jul.–Dec. 85	Jan.–Dec. 86	Jan. 87 onwards
	1,50,000 (Urban Nadiad)	Jul.–Dec. 86	Jan.–Dec. 87	Jan. 88 onwards
	0.5 Million (Rural + Urban)			
	Phase 2			
Extension	0.5 Million (Rural + Urban)	July.–Dec. 87	Jan.–Dec. 88	Jan. 89 onwards
	Phase 3			
Operational	Kheda District 3.0 Million	Jul. 88–Jun. 89	Jul. 89–Dec. 90	Jan. 90 onwards

Table 5. A comparative study of the expenditure to control malaria in Kheda distt., Gujarat

Method of control	Expenditure in lakh rupees (Based on 1985 prices)		
	Nadiad Taluka (0.35 M. Pop.)	Three Talukas (1 M. Pop.)	Kheda Distt. (2.7 M. Pop.)
1. DDT	12.0	34.0	92.0
2. HCH	14.0	37.0	100.0
3. Malathion	70.0	199.0	537.0
4. Integrated control	18.0	37.0	85.0

control malaria using malathion (Table 5). The increase in area to 1 million population further reduces the cost of integrated control whereas the cost of insecticidal control increases proportionately. Calculations for malaria control in Kheda district show that integrated control would cost Rs. 85 lakhs as against Rs. 92, Rs. 100 and Rs. 537 lakhs required for DDT, HCH and malathion respectively. Integrated control of malaria would, therefore, be the cheapest method with many collateral benefits. If benefits from other schemes of fish production and social forestry are taken into account, malaria control can be fully sustained by these schemes, besides the advantage of a better and healthy environment.

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Filariasis Control by Integrated Vector Management

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INTRODUCTION

Lymphatic filariasis, caused by a nematode *Wuchereria bancrofti* and transmitted by the urban mosquito, *Culex quinquefasciatus*, is constantly increasing in magnitude and direction in India. According to official estimates[1,2] the population exposed to risk has increased twelve-fold from 25 million in 1953 to 304 million in 1981. However, according to a Citizen's Report[3], every third person in India runs the risk of acquiring filariasis and it was concluded that the disease has spread due to mismanagement of environment. The Government had as early as 1969, directed all State Governments that; (i) adequate arrangement for disposal of sewage and sullage, (ii) prevention of filariogenic conditions in town expansions and new towns, and (iii) recurrent anti-larval measures against the filariasis vector should be the main plank of operations under the National Filariasis Control Programme (NFCP). Due to administrative reasons, the first two directives cannot be enforced by the NFCP as these fall under the purview of different departments like Municipalities, Public Works, Town Planning etc. Thus, the NFCP operations were mainly confined to routine larvicidal operations, which are beset with many functional and administrative constraints. So the problem continues to persist.

The Vector Control Research Centre, Pondicherry (VCRC) carried out extensive studies for five years on the reasons for persistence of filariasis and on the vector mosquito. It was concluded from this study that it would be possible to drastically reduce the transmission index for the disease in Pondicherry by an integrated approach to vector control, with major emphasis on environmental management. A five-year project to control filariasis was launched by the VCRC with the cooperation of Government of Pondicherry in 1980, with financial assistance from the Indian Council of Medical Research. The basic strategy adopted and the results achieved are presented in this report.

Pondicherry town and the surrounding urban agglomeration has a population of 2,72,000 and covers an area of 59.38 km². For operational

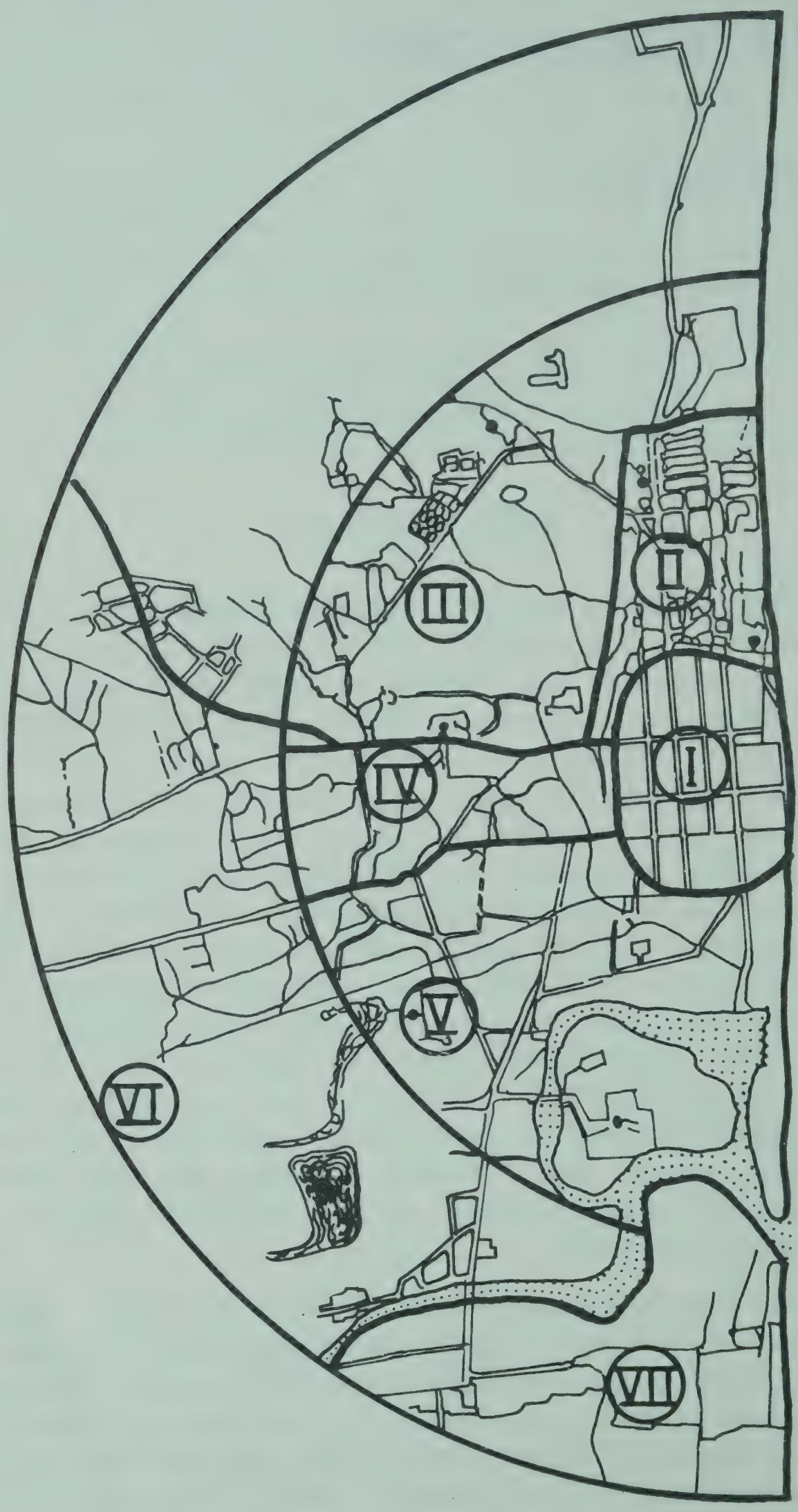

Fig. 1: Map of Pondicherry showing operational zones. (Zones I and II are under Govt. of Pondicherry and zones III to VI under VCRC operation).

convenience, the area is divided into seven zones out of which zones 1, 2 and 7 are under the operational control of the Pondicherry State Unit of the National Filariasis Control Programme. The remaining five zones, as well as a check area (Cuddalore Town in neighbouring Tamil Nadu state) are under the operational programme of the Vector Control Research Centre (Fig. 1).

OBJECTIVES

(i) To show drastic reduction in the microfilaria rate in the age group 0–8 years at the end of 5 years;
(ii) Development of appropriate methodology for vector control in a large town using integrated pest management technology;
(iii) Reduction in vector density and man-vector contact;
(iv) Study of cost benefit analysis, and
(v) Enlisting of community participation on a permanent basis.

MICROFILARAEMIA IN PONDICHERRY

A mass night blood survey was carried out to determine microfilaraemia in the population before the start of the control project. Since the distribution of the population is not homogenous, stratified random sampling with proportional allocation of 10% was adopted (Fig. 2). A total of 25,254 samples were collected out of which 2,169 were found to be positive for microfilaria thus giving an overall mF rate of 8.59%. Average mF density was found to be 10.72 and the highest mF count of 280/20 mm^3 was recorded in one case. In the present survey median mF density was found to be 4.39. Infectivity potential of the human population to vector population was found to be 3.74. The mF rate in Cuddalore was 10.2%.

CONTROL STRATEGY

There are about 2600 wells, a very large marshy swamp receiving effluents from two storm water canals (into which all the sullage water from houses empties), over 6000 cess pits, hundreds of vacant housing plots also receiving domestic effluents and over 200 kms of drains all profusely breeding *Culex quinquefasciatus*. Thus Pondicherry presented a picture of one of the most insanitary towns.

To make control strategy efficient, economical and environmentally sound INTER-SECTORAL COLLABORATION and COMMUNITY PARTICIPATION were given special emphasis.

Since integrated pest management utilizes all suitable techniques and methods in a compatible manner to maintain the pest population below a critical level, the following methods of vector control were used in this programme; (i) Environmental management, (ii) Biological control, and (iii) Chemical control.

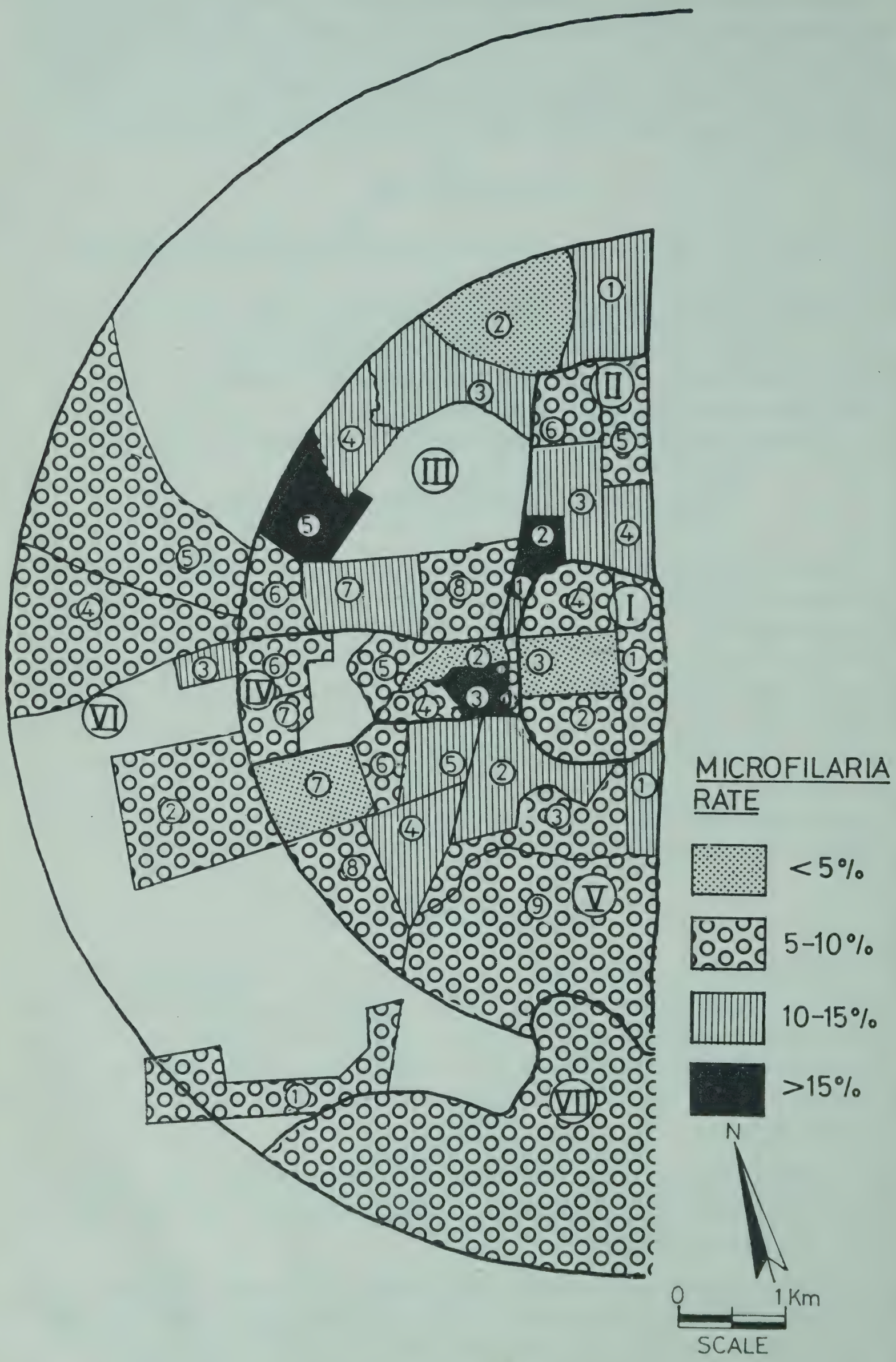

Fig. 2: Microfilaria rate in the study area.

A concerted action-oriented plan was developed by the VCRC and Govt. of Pondicherry which stipulates that all departments put in a coordinated effort, in order to demonstrate nil transmission of filariasis at the end of five years. To coordinate the activities of different developmental agencies and to remove administrative bottlenecks, two committees were formed. The members of the committees interacted with other departments involved through a High Level Committee which met once in three months and an Operational Committee which met every month to initiate measures for its smooth implementation.

Experiments were designed by the VCRC to study the environmental factors responsible for vector proliferation and demonstrate control through manipulating the environment. Comparative cost benefit analysis of environmental methods and the conventional methods was also made. Information was gathered as follows:

(i) Distribution of breeding places was studied by mapping of all water bodies;
(ii) Relative importance of different types of habitats contributing to mosquito emergence was obtained by calculating daily emergence throughout the year;
(iii) Number of different breeding habitats available in each area was determined in different seasons;
(iv) Species composition of mosquitoes breeding in different habitats and in different seasons was studied;
(v) Resting density of vector mosquitoes was monitored fortnightly from 16 catching stations by standardized methods;
(vi) Biting density was determined weekly using standardized methods;
(vii) Parity status, infection rate and infectivity rate in the vector were determined for calculating transmission index;
(viii) Environmental factors conducive to mosquito breeding were studied;
(ix) Key factors for achieving community participation were identified.

ROLE OF ENVIRONMENT IN FILARIASIS

The VCRC demonstration project is directed towards controlling the immature stages of mosquitoes in different water bodies. Therefore, the environment most conducive for vector proliferation is described below. The water bodies were classified into vacant plots, cesspools, cesspits, cement tanks, septic tanks, storm water canals, drains, marsh, coir pits, river and wells. Total surface area available under these categories varies from season to season.

Vacant plots and cesspools

Increasing urban population pressure resulted in the conversion of low lying agricultural lands into housing plots. Most of these plots were bought

for speculative purposes, and as a result even in developed colonies, innumerable vacant plots can be seen. The sullage and sewerage water from constructed houses is let into low-lying vacant plots. This mixing of sullage water with rain water, completely changes the environment to favour *C. quinquefasciatus* breeding in vast areas.

Cesspools are natural depressions of much larger dimensions and generally accumulate rain water. This type of water body does not provide a favourable breeding environment for *C. quinquefasciatus*, but, unfortunately, people residing nearby either dump solid garbage or waste water into them, thereby creating a favourable breeding ground for *C. quinquefasciatus.*

Cesspits

Since there is no drainage system in slum areas all sullage and sewerage water is let into a pit dug outside each house. Generally, these pits are about 1 metre in diameter, and accumulate all effluents thus becoming a favourable breeding places for *C. quinquefasciatus.* There are over 1800 pits breeding mosquitoes in the study area.

Cement tanks

Being a centrally subsidized Union Territory, the credit facilities are good and this has resulted in increased building constructions. Cement tanks of the size of 3–6 sq.m are constructed for storing water by the building contractors. Though these tanks contain clean water, *C. quinquefasciatus* breeds in them. Many people however construct septic tanks first without covering them and use the different compartments as storage places for water, thereby creating breeding places.

Septic tanks

Except in slum areas, each house has its own septic tank for sewage disposal with a vent pipe provided for the escape of noxious gases, and an excess water outlet. Since the ends of the vent pipes are not covered, mosquitoes enter through these and lay eggs and breeding takes place. Also, the excess water is let out either into a drain or into the open where a puddle is formed, which breeds mosquitoes. Even *Aedes* has been found breeding in septic tanks[4].

Storm water canals

There are approximately 15 to 20 kms of large canals which were originally designed to carry storm water to the sea. Due to unplanned urbanization, waste water and raw sewage from houses and colonies now flow into these canals. As a result polluted water flows at slow speed throughout the year, stagnating along the course. The quantum of effluents from the houses and colonies is about 35 million litres per day. The storm water canals are constructed with a slope of 1 cm for every 100 m which is sufficient to have a water flow of 1 meter per second when there is a large volume of water. This is

seasonal. For the adequate flow of sullage water the gradient should be much higher. Therefore, stagnation takes place in these canals except during rainy season.

Drains

Besides the storm water canals, about 80–90 km of feeder drains are present and they are either L-shaped or U-shaped on either side of the roads, collecting water from the households. Many U-shaped drains are partially covered. Householders and restaurant owners push all solid garbage into these drains, which are not cleaned regularly, and as a result, these partially closed drains breed mosquitoes. In the evening one can see swarms of mosquitoes emerging out of the openings. Being partially closed, these drains are neither cleaned nor sprayed.

Besides these, gully traps provided in the drains form permanent depressions. Therefore, even if the gradient in the drain is perfect, water always stays in these depressions providing permanent breeding places. Nearly half of the total length of drains can be called trenches, because they have no outlets and water stagnates providing excellent breeding ground for *C. quinquefasciatus*.

Marshy swamp

Since there is no exit for the two major storm water canals, Uppar and Grand canals, water is ultimately let into a low-lying area near the sea (Dubrayapet) and as a result, an area measuring about 200 hectares was completely inundated. This low lying area of Dubrayapet formed a marshy swamp with the accumulation of sewage and sullage water. This swamp accounted for nearly half the total mosquito population in Pondicherry.

Coir pits

In marshy areas and along river banks people dig pits to soak coir husk for making ropes. These also breed *C. quinquefasciatus*. There are 5000 such pits in the study area.

Rivers

A branch of Ginji river running on the southern border of the study area receives sullage water from the western side of the town near Murungambakkam. As a result of mixing untreated sullage water with river water, *C. quinquefasciatus* breeds profusely along the margin of the river.

Wells

Since piped water supply is provided to almost all houses, the old wells in many houses became disused. Leaves and garbage dumped in wells make them good breeding places.

ENVIRONMENTAL METHODS OF CONTROL

Mosquito control in marshy swamp at Dubrayapet

The swamp which received nearly 75% effluent discharged from all the drains was found to be the single largest mosquito breeding source. The permanent solution for this was; (a) providing an opening into the sea at a point which is 2.6 km away from present site, (b) forming a lido by dredging

Table 1. Environmental improvement for vector control and cost benefit analysis

Source reduction work	Year	Surface area reduced per m^2	Cost of operation (In Rs.)	Cost of insecticides required to treat the area (In Rs.)	Net savings during the years (In Rs.)
			(a)	(b)	(b − a)
Filling	1981	19,877	17,918	55,126	37,208
	1982	4,906	11,259	15,874	4,615
	1983	7,093	18,739	23,769	5,030
	1984	14,574	27,743	63,994	36,251
	1985	2,406	4,940	10,885	5,945
	Total	48,856	80,599	1,69,648	89,049
Channelization	1981	ND	ND	ND	ND
	1982	3,253	1,406	10,525	9,119
	1983	4,700	4,091	15,750	11,659
	1984	10,400	681	45,667	44,986
	1985	—	—	—	—
	Total	18,353	6,178	71,942	65,764
Environmental manipulation, desilting and deweeding	1981	2,79,886	44,696	14,927	
	1982	10,74,243	70,658	66,842	
	1983	16,22,705	1,15,970	1,04,574	
	1984	16,82,048	1,47,112	1,42,040	
	1985	13,77,768	2,18,698	1,19,917	
	Total	60,36,650	5,97,134	4,48,300	
Draining of marshy area*	1981	5,60,000	3,000	7,76,533	7,73,533
	1982	5,60,000	3,000	9,05,956	9,02,956
	1983	5,60,000	3,000	9,38,311	9,35,311
	1984	5,60,000	3,000	12,29,511	12,26,511
	1985	Nil	Nil	Nil	Nil
	Total		12,000	38,50,311	38,38,311

*By this method breeding could be prevented for six months. During summer season opening manually is not possible.
Once every year mouth of the lagoon has to be opened at an expenditure of Rs. 3,000.

so that the shallowness of the water body is reduced and water accumulating capacity increases, since deep water bodies without a shallow borderline are generally unfit for *C. quinquefasciatus* breeding. Such lidos provide the environment suitable for biological predators like fish, and (c) reclaim the waste land by filling and use it for forestry or recreational purposes. The VCRC attempted all these methods for the control of vectors and the results are summarised in Table 1. Total land reclaimed in this area was 48.856 m^2 thereby reducing breeding potential. In the permanently reclaimed land afforestation was undertaken. Since this area is now frequented by many birds, the vector mosquito may turn to birds for their blood meals. It is worth mentioning here that the preferred blood for this species is avian blood and fecundity of the species actually increases when fed on avian blood.

Excess water in this area (lagoon) was drained frequently by keeping open the mouth of Veerampattinam river. Frequency of the opening depended on the volume of water present in the lagoon. However, by keeping open the mouth, 56 hectares became free from breeding during summer season due to receding water-line. This operation, coupled with pumping of sullage water into the sea has resulted in the drastic reduction of mosquito breeding. Water started flowing for the first time in the cunette in the Uppar as well as Grand canals. Flowing water is unfavourable for egg laying by *C. quinquefasciatus.* The Pondicherry Government has now decided to keep the mouth of Veerampattinam river permanently open, using their own resources (Table 2).

Table 2. Expenditure and returns

Item	Expenditure in Rs	Returns in Rs	
		Direct as fuel, wood or land	Indirect as saving on insecticides
A. Filling of coir pits area	5312.00	620000.00*	110628.80
B. Casuarina plantation	6428.00	20000.00	86324.00
C. Fish pond	6000.00	3000.00**	44848.00
D. Eucalyptus plantation	7128.00	8000.00	23688.00
E. Land reclamation of 560000.00 sq.m. area (estimated)	Anticipated Expenditure to keep the mouth permanently open—4 crores.	In the reclaimed area of 560,000.00 m^2 about 2000 housing plots of 240 m^2 area can be laid out. If they are sold for Rs. 20000 per plot this will fetch Rs. 4,00,00,000.	

*Reclaimed land could be sold as residential housing plots of 240 sq.m. each worth Rs. 20,000 at prevailing market rates.

**Rs. 3000 worth of *Tilapia*, an edible fish, could be cultured every year.

ENVIRONMENTAL MANIPULATION IN OPEN DRAINS

The basic requirement for preventing *C. quinquefasciatus* breeding is to maintain a surface water velocity of 30 cm/sec. Mosquito control was attempted in 10 U-shaped drains and 5 "kutcha" drains by increasing the flow of water. These drains were desilted regularly and surface velocity, silt deposition rate and breeding status studied. Unfortunately there are very few drains which have got the right gradient to maintain a constant flow.

Most drains did not have proper gradient. Silt deposition rate was also found to be higher due to type of soil and prevalent coastal wind. Coastal alluvial sand facilitated faster silt deposition. Sandy soil was regularly being pushed into the drain by wind throughout the year. Red feralitic soil got washed from the upper regions and deposited in the low-lying drains during rainy season. If these drains were to be maintained free from breeding throughout the year, frequent desilting was necessary. The cost of maintaining flow in these drains by environmental and chemical methods was comparable.

Control in closed drains

There were several large drains covered with slabs. Many temporary constructions had come up over these closed drains. Since all solid garbage was dumped in these drains, resulting in blockage, they could neither be cleaned nor sprayed. Therefore, sea water was brought in tankers and let into these drains. This not only flushed the drains but also destroyed mosquito breeding due to environmental imbalance created by sea water.

During the last five years, a total surface area of 48856 m^2 was permanently reduced by filling alone, 18,353 m^2 by channelization and another 6,036,650 m^2 surface area has been kept free by other methods like desilting, deweeding etc. apart from draining a marshy area of 560,000 m^2. These steps have resulted in a permanent saving in expenditure of about Rs. 4,000,000 (US $ 332,000) (Table 1).

ENVIRONMENTAL AND ECOLOGICAL IMPACT

When the VCRC started the project in 1980, Pondicherry had the dubious distinction of being grouped among one of the many towns in South India which are well known for the mosquitogenic conditions and are notorious for the characteristic stench emanating from the choked drains. It has now been publicly acknowledged that, within 2 years of starting this project, Pondicherry is one of the few towns without mosquito nuisance. Apart from this, several developmental works have been started by the Govt. of Pondicherry at the initiative of the VCRC, which when completed will go a long way in beautifying the environment. The Dubrayapet swamp now presents the appearance of a wooded recreational park and by the time the

project ends in 1985, this will be declared a recreational area with fishing and boating facilities. The wild life conservator of Pondicherry is also helping in this process, and a turtle breeding park and a bird sanctuary are also planned. All this is a slow process and the VCRC is confident, from the pace of progress during the two years, that the planned targets will be achieved.

BIOLOGICAL CONTROL

Gambusia affinis were released in all vacant plots to control mosquito breeding. Besides, 2,575 wells in zones No. 3, 4, 5 and 6 were stocked with *Gambusia* at quarterly intervals. Except in some wells where pollution is high *Gambusia* gave very good control. However, *Gambusia* had to be released very frequently because of poor survival and, therefore, *Tilapia* was substituted in wells.

CHEMICAL CONTROL

Though the major emphasis of this project is to control the vector by environmental sanitation and source reduction these methods are time consuming and the result perceptible only after a period of time. They also need the cooperation of other developmental agencies, which usually fail to appreciate the urgency of the present project. Therefore, to keep the vector population below the critical level all the breeding places where no other method worked were sprayed weekly with fenthion and phenthoate. Operational efficiency was maintained by strict supervision.

COMMUNITY PARTICIPATION

As in any public health programme active community participation in mosquito control is necessary. The phrase community participation has become the phrase of the century and many papers and articles have been written on this subject. But very few of them have yet identified, what they actually expect from the community. Dr. T. Ramachandra Rao once said that the community is always participating in programmes by financing indirectly through tax. Therefore, the sort of participation we are expecting should be spelt out before launching the programme. In Pondicherry we defined the type of participation needed from the community and identified the factor hampering effective participation. To achieve community participation VCRC interacted vertically by organizing opinion leader training programmes and horizontally by mass public health education programmes through 6,000 pamphlets, 9,000 posters and 20 hoardings. The designs were developed keeping in mind the religious sentiments of the people and were found highly acceptable and educative. However, the opinion leader training programme was not found to be very useful because once a leader was

approached another group felt neglected. Therefore, a door to door health campaign was initiated and till the end of the year a total population of 1,00,000 was covered.

INTER-SECTORAL COLLABORATION

As stated earlier several departments are responsible for maintaining good sanitation and each of them functioned compartmentally and preventing mosquito breeding was certainly not considered their responsibility. After innumerable meetings of the High Level Committee there were only piecemeal solutions of the problems of maintaining proper gradients in drains, rectifying defective constructions, enforcing civic laws, unplanned townships,

Table 3. Indoor resting density (no. of females per man hour), infection and infectivity rates of *Culex quinquefasciatus* in different catching stations

VCRC area	Density				1985			
	1981	1982	1983	1984	Density	No. dissected	Infection rate	Infectivity rate %
1. Saram	27.5	29.5	9.5	3.3	6.8	446	15.9	0.2
2. Karuvadikuppam	11.6	8.3	4.9	2.4	1.8	125	4.8	0
3. Jeevanandapuram	12.3	8.4	7.6	2.6	6.5	448	9.4	0.2
4. Govindasalai	37.8	25.8	22.0	10.3	19.5	1202	14.9	0.7
5. Kosapalayam	28.1	44.8	10.3	3.8	12.4	698	9.9	0.4
6. Vambakeera-palayam	43.9	55.5	22.0	14.8	17.0	873	11.3	0.8
7. Vanarapet	20.8	11.3	5.9	2.0	8.5	550	9.8	0
8. Nellithope	37.5	15.7	5.9	1.9	3.0	207	11.6	0
9. Thengathittu	9.8	6.0	2.0	1.2	0.6	42	4.8	0
10. Mudaliarpet	14.9	8.2	4.3	1.8	3.3	228	7.0	0.4
11. Keerapalayam	31.6	15.7	8.4	1.2	6.2	425	8.0	0.5
12. Subbiah Nagar	44.7	28.4	9.3	3.8	5.9	409	16.1	0.7
13. Reddiarpalayam	14.0	7.1	2.1	0.8	3.4	233	1.7	0
14. Nainar Mandapam	17.0	9.2	2.0	0.8	1.0	66	10.6	0
Overall average	25.1	19.2	8.3	3.6	6.9	5952	11.3	0.4
NFCP Area								
1. V.O.C. Nagar	34.8	35.9	31.8	22.9	38.1	1587	14.6	0.8
2. Muthialpet	107.9	49.0	43.1	35.3	46.4	1850	21.4	0.9
3. Kurichikuppam	28.7	51.8	55.4	66.9	39.5	1495	17.1	0.6
Overall average	57.1	45.6	43.4	41.7	41.4	4932	17.9	0.8
Check Zone Cuddalore	45.0	68.9	55.7	40.4	64.1	5060	9.3	0.1

etc. It was only in June 1984 that the Government of Pondicherry placed all the concerned departments like Public Works, Municipalities and Town Planning under an enthusiastic Secretary and since then there was excellent coordination of the activities of the various departments in a common effort to prevent mosquito breeding. This was one of the biggest achievements of the Project and it gives hope that the local Government will sustain the gains achieved after the termination of the Project. Over Rs. 50 lakhs (US $ 500,000) have so far been spent by Pondicherry Government for mosquito control oriented works.

RESULTS

The results at the end of four years are summarized in Tables 3 to 6. A reduction of 80–100% in man biting densities has been maintained. Both the risk of infection index and the annual transmission index have been reduced drastically. In all localities which are under the VCRC project, the people now cooperate since they are now living free from mosquito nuisance. This is one of the major gains of the project as the people had believed that they would never have any freedom from mosquito bites. All the departments engaged in developmental activities are now aware of mosquito breeding and that this can be prevented by better planning and implementation of their works. This is the second major gain. There are several other collateral benefits resulting from this project. They are (1) Breeding of Japanese Encephalitis vector has

Table 4. Annual transmission index (Beye and Gurien, 1960)

	1979–80 Pre-control	1981	1982	1983	1984	1985
Estimated no. of mosquitoes biting a man in one year (a)	26203	8238	3181	3222	1662	3617
Proportion of mosquitoes infective (from biting collections only) (b)	0.0086	0.006	0.004	0.0066	0.0079	0.0061
Estimated no. of infective bites a man receives in a year	225	49	13	21	13	22.00
Number of infective larvae per infective mosquito (c)	2.0	4.0	2.6	2.9	3.72	3.50
Annual transmission index (a × b × c)	450	197	33	62	49.00	77.00

Table 5. Man biting rate (no. of mosquitoes biting/man/night) of *Culex quinquefasciatus* during different years and percentage reduction in man-vector contact

Month	1979–80 (Base line data)	1981		1982		1983		1984		1985	
	Man biting rate	Man-biting rate	% reduc-tion	Man-biting rate	% reduc-tion	Man-biting rate	% reduc-tion	Man-biting rate	% reduc-tion	Man-biting rate	% reduc-tion
Jan.	58.0	33.0	43.1	11.5	80.2	8.5	85.4	9.0	84.4	5.0	91.3
Feb.	54.0	28.5	47.2	20.0	63.0	3.5	93.3	8.5	84.2	8.0	85.1
Mar.	84.5	9.0	89.3	12.0	85.8	6.0	92.9	4.5	94.6	0.5	99.4
Apr.	48.0	7.0	85.4	1.0	97.9	0.5	99.0	1.5	96.8	1.5	96.8
May	60.0	14.5	75.8	5.0	91.6	0.5	99.0	0	100.0	0.5	99.2
Jun.	32.5	4.0	87.7	3.0	90.8	2.5	92.3	4.0	87.8	1.5	96.3
Jul.	82.0	61.0	25.6	11.0	86.6	6.5	92.0	2.0	97.5	8.0	90.2
Aug.	67.0	40.5	39.6	1.5	97.8	9.0	86.6	3.5	94.8	23.0	65.9
Sept.	86.5	27.0	68.8	3.0	96.5	17.5	79.8	2.5	97.1	23.5	72.8
Oct.	169.5	22.5	86.7	5.5	96.8	10.5	93.8	12.0	89.9	19.5	83.5
Nov.	57.0	17.0	70.2	9.5	85.1	13.5	76.3	2.5	95.6	15.5	73.1
Dec.	118.5	17.5	85.2	22.0	81.5	20.5	22.7	4.5	96.2	12.0	89.9
	76.5	23.5	69.3	8.8	88.5	8.3	89.2	4.5	94.1	9.9	87.1

Table 6. Risk of infection index

	1979–80 Pre-control	1981	1982	1983	1984	1985
Average biting density Per Man Hour (a)	6	1.95	0.73	0.8	0.379	0.841
Proportion parous (b)	0.8025	0.445	0.4242	0.406	0.4094	0.592
No. with infective stage larvae	15	24	9	14	18	24
Proportion infective to total parous (c)	0.012	0.013	0.0108	0.0162	0.0192	0.0104
Risk of Infection index (a × b × c)	0.0578	0.0113	0.0033	0.0053	0.0030	0.0052

been drastically reduced and as a result there was no outbreak of this disease in Pondicherry. (2) Drastic reduction in the incidence of gastro-enteritis. Finally the whole of Pondicherry is now a better place both aesthetically and from the health stand point than it was before starting the project.

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Malaria Control in Bombay by Legislative Measures and other Non-insecticidal Methods of Vector Control

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INTRODUCTION

The continued hyperendemicity of malaria in Bombay in the early years of the present century necessitated detailed investigation of its causes to suggest remedial action. The prominent investigations were those conducted by Bentley (1908–1911) and by Covell (1927–1928). The hyperendemicity was decisively proved to be because of the existence of a large number of breeding places for *Anopheles stephensi*, the lack of suitable organisation for *A. stephensi* control, aggregation of labour in project works and the lack of legislation to support *A. stephensi* control activities.

Covell in his monumental report "Malaria in Bombay 1928" has enumerated the 'essential requirements' for the conduct of anti-malaria work, as under:

—The effective organisation of the malaria staff.
—Unity of control of anti-malaria measures over the whole island of Bombay.
—The adoption of a systematic campaign with the object of abolishing all permanent breeding places of the malaria carrying mosquito of Bombay.
—Preventive measures to be of a permanent nature wherever possible.
—The provision of effective legislation to enforce the necessary measures.
—This legislation is to apply to the Railways, all Government Departments, and in fact to all public and private bodies in the island of Bombay.
—Active cooperation in the carrying out of preventive measures on the part of the officers controlling the Railways, Government Departments and other public bodies, and on the part of the Municipality itself.

1065
COMMUNITY HEALTH CELL
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The present anti-malaria organisation of the Municipal Corporation of Greater Bombay owes its origin to the recommendations of Bentley and Covell. The mainstay of these recommendations and the vector control methodology adopted over the years has been in a large measure, the enforcement of legislative measures for source reduction, biological control (use of larvivorous fish species) and proper coordination of different agencies. However, since the advent of new larvicides and insecticides, chemical control has been suitably incorporated in the Integrated Control Strategy but essentially for abatement of mosquito nuisance. Malaria vector control continues to depend on non-insecticidal methods. Malaria incidence in recent years is depicted in Table 1.

Table 1. Monthwise malaria cases

Month	Positive		
	1983	1984	1985
Jan.	184	125	75
Feb.	124	109	52
Mar.	156	157	96
Apr.	184	330	64
May	324	410	157
Jun.	404	236	129
Jul.	560	236	220
Aug.	467	264	139
Sep.	638	177	153
Oct.	331	108	128
Nov.	200	129	82
Dec.	128	49	76
Total	3700	2330	1371
Pv	3348	2074	778
Pf	334	239	39
Mix	18	17	6
Total	3700	2330	1371

VECTOR CONTROL—LEGISLATIVE PROVISIONS AND OTHER NON-INSECTICIDAL MEASURES IN BOMBAY

Enactment and enforcement of existing legal provisions under the Bombay Municipal Corporation Act as well as the planning and implementation of other methods of vector control have a definite relevance to the bionomics of the predominant urban malaria vector species *Anopheles stephensi*. *A. stephensi* breeds in fresh, preferably constantly renewed water. It breeds in

dark places and also those exposed to sunlight. In order to reach its breeding place it requires only a narrow opening (1.5 mm). These three factors underscore the importance of mosquito proofing of cisterns, suction tanks, overhead water storage tanks and wells and regulation of new water storage installations and building construction sites.

Legislative measures

Provisions

The present provisions under the Bombay Municipal Corporation Act, (Bombay Act No. III of 1888—modified upto 1982) so far as they relate to vector mosquito control, can be categorised under four heads to facilitate comprehension.

(1) *Remedial actions in respect of existing situations* (section 381 [1]) to ensure

—Mosquito proofing of cisterns, water storage tanks, wells, septic tanks etc.
—Filling up of wells, pools, ditches and ponds.
—Removal/demolition of masonry tanks, garden tanks, odd articles or replacement of non-mosquito proof cisterns.

Under this section, suitable bye-laws are framed calling for advance money from textile mills, industrial units, building construction sites and private property owners to meet the expenses of larvicidal treatment to mosquito breeding situations which are of temporary nature. Monsoon changes are covered under these provisions.

(2) *Regulation of new works* (section 381 [A])

Under the provisions of this section it is mandatory for the property owners to obtain written permission from the Municipal Commissioner (who delegates some of the powers conferred upon him to other officers) before digging/constructing wells, tanks, ponds, water fountains, swimming pools etc., and before installation of new cisterns.

The bye-laws framed in support of this section specify the policy and requirements in respect of each item e.g., specifications of the municipal approved cisterns. Only those cisterns which conform to specifications are permitted for installation. Granting water connection to new cisterns is subject to production of no objection certificate from the malaria department.

—Open surface wells are no longer permitted.
—Tube-wells are encouraged.
—Similar specifications and policies exist for construction of swimming pools, water fountains etc.

(3) *Access to cisterns* (section 274 [1])

A special section is incorporated in the Bombay Municipal Corporation Act to ensure that each cistern is provided with a *safe*, *easy* and *permanent* means of access (i.e., an iron ladder with lower ends fixed in a cement concrete block and upper ends turned to serve as hand grips and bolted securely).

(4) *Other provisions* under different sections provide for

—Execution of work at defaulter's cost.
—Penalising offences with fines.
—After-conviction actions for continuing offences.

MACHINERY AND METHODS OF ENFORCEMENT OF LEGAL PROVISIONS

In order to detect defects and irregularities, to initiate suitable legal actions in pursuance of the Bombay Municipal Corporation Act, periodical inspection of all the premises is ensured. Relevant data on all the permanent potential mosquito breeding places including the number of flights of stairs required to be taken for cistern inspection is gathered and continually updated

Table 2. Workload summary of mosquitogenic situations

Items	City	Suburbs	Total
1. Area sq. km	68.71	369.00	437.71
2. Population	32,58,117	49,69,215	82,27,332
3. Premises	35,174	78,540	1,13,714
4. Cisterns	92,966	90,031	1,82,997
5. Flights	1,26,650	1,06,129	2,32,779
6. Wells			
(a) Open	232	4,381	4,613
(b) Partially open with trap door	122	174	296
(c) H.C.C.	1,354	416	1,770
(d) Tube	258	1,406	1,664
Total wells	1,966	6,377	8,343
7. Mill tanks	52	18	70
8. Overhead tanks	209	148	357
9. Masonry tanks	2,746	1,349	4,095
10. Garden tanks	60	129	189
11. Fountains	222	202	424
12. Static tanks	44	3	47
13. Cellars	137	38	175
14. Swimming pools	44	39	83
15. Village ponds	6	71	77
16. Storm water entrances	31,886	4,446	36,332
17. Open channel drains (km)	151.32	825.50	976.82
18. Septic tanks/aquaprivies	760	23,803	24,563
19. Cooling tower	678	678	1,356

(Table 2). On the basis of this workload, the municipal ward areas have been divided and subdivided to correspond with week days. Norms of inspection and team compositions have been accordingly fixed under which each junior overseer in-charge of a 'section' (comprising of a number of premises with a total of 1440 flights of stairs) has to complete the work of 40 flights a day. This ensures completing his beat for 'cistern inspection work' in six weeks. Ground inspections are, however, done on weekly basis (Fig. 1).

On detecting and recording the defects, legal notices are issued by the junior overseers and served under the signature of the Pest Control Officer of the ward. On non-compliance of notice requisitions prosecutions are launched.

The amount of money received as advance deposit towards the cost of weekly larviciding work during the year 1985 is Rs. 13,70,700 as shown in Table 3.

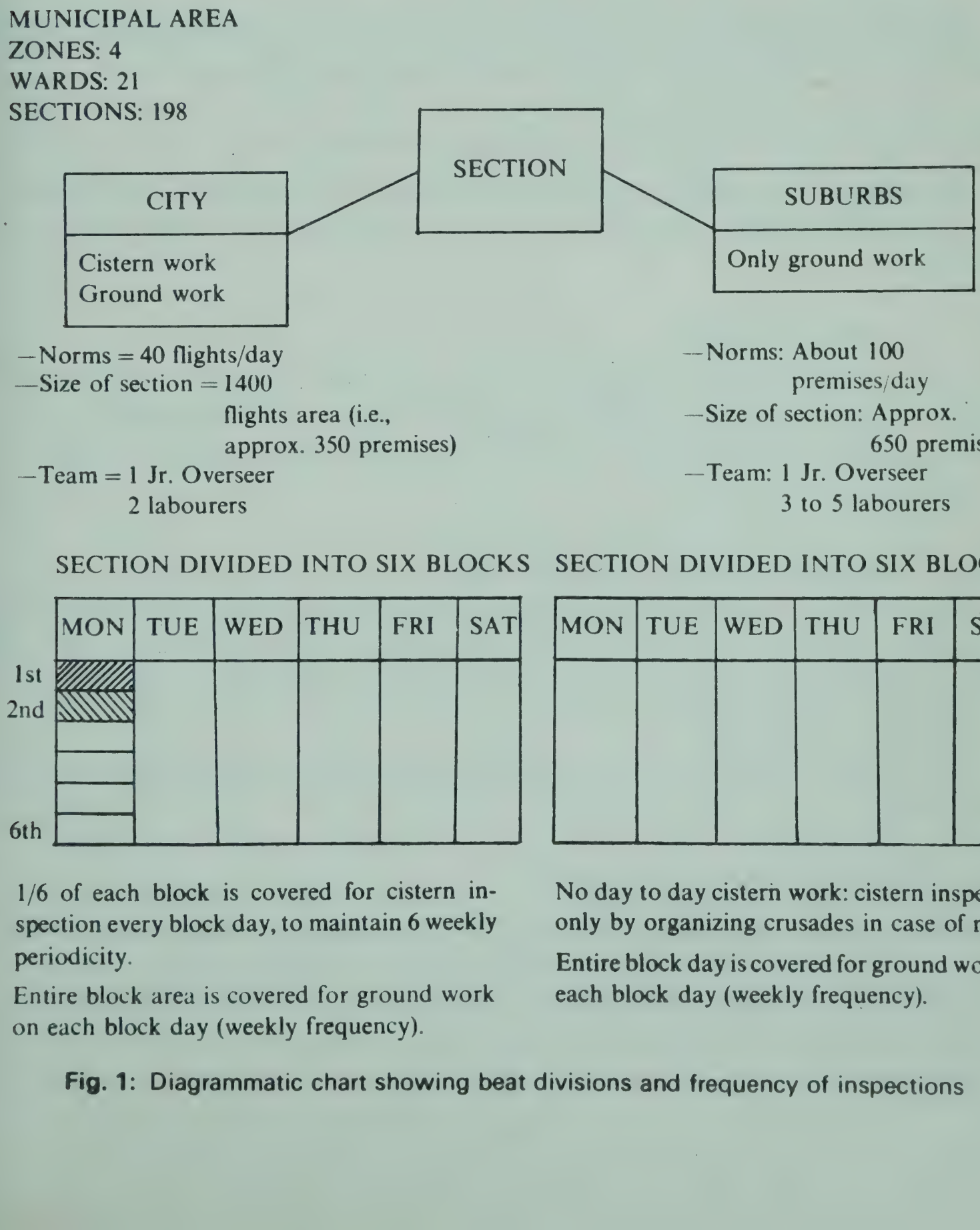
MUNICIPAL AREA
ZONES: 4
WARDS: 21
SECTIONS: 198
SECTION
CITY
Cistern work
Ground work
—Norms = 40 flights/day
—Size of section = 1400 flights area (i.e., approx. 350 premises)
—Team = 1 Jr. Overseer
2 labourers
SUBURBS
Only ground work
—Norms: About 100 premises/day
—Size of section: Approx. 650 premises
—Team: 1 Jr. Overseer
3 to 5 labourers
SECTION DIVIDED INTO SIX BLOCKS
MON TUE WED THU FRI SAT
1st
2nd
6th
1/6 of each block is covered for cistern inspection every block day, to maintain 6 weekly periodicity.
Entire block area is covered for ground work on each block day (weekly frequency).
SECTION DIVIDED INTO SIX BLOCKS
MON TUE WED THU FRI SAT
No day to day cistern work: cistern inspection only by organizing crusades in case of need.
Entire block day is covered for ground work on each block day (weekly frequency).

Fig. 1: Diagrammatic chart showing beat divisions and frequency of inspections

Table 3. Deposit amount received in response to legal actions for larviciding during 1985

Locality	Building construction work	Monsoon work	Miscellaneous work	Total
City	96,660	2,97,875	2,15,665	6,10,200
Western suburbs	1,43,750	1,32,650	2,46,400	5,22,800
Eastern suburbs	44,350	1,36,050	57,300	2,37,700
Total	2,84,760	5,66,575	5,19,365	13,70,700

Figures in rupees.

OTHER NON-INSECTICIDAL MEASURES OF VECTOR CONTROL

Besides the application of legislative measures, the modes of control which do not involve the use of larvicides and insecticides are as under.

(1) *Avoidance of creation of new mosquito breeding places*

Digging of new surface wells is not permitted and sinking of tube-wells is, encouraged instead. Similarly, construction of new water fountains is not permitted.

(2) *Observing 'dry days'*

Water fountains, garden tanks and masonry tanks already in existence are structurally modified to enable flushing out all water to avoid stagnation. On the weekly inspection day, the beat overseer ensures that such water containers are kept dry.

(3) *Cleaning of roof gutters of textile mills*

Special staff comprising of 27 workers is appointed every year for four months of monsoon to visit the textile mills as per programme and to clean/treat all roof gutters which are specially vulnerable to *A. stephensi* breeding in mill areas.

Fire buckets in mills are also emptied and refilled by mill staff deputed for this work.

(4) *Introduction of larvivorous fish*

Permanent water bodies, particularly cellars holding water, static tanks, mill ponds, open wells are all stocked with *Poecilia reticulata* (guppies). Introduction of fish in new situations and in situations where their number is depleted, is done every Saturday by the respective junior overseer under ward PCOs.

(5) *Microbial insecticides and Insect Growth Regulators*

Field testing of Bti (H 14) and Methoprene has been done against different mosquito species. But these agents have not been incorporated in routine control programmes as yet.

(6) *Coordination of various agencies*

"Mosquito Abatement Committee" constituted under the Chairmanship of the Mayor of Bombay meets every six months to review the progress of the matters outstanding with various Government and semi Government agencies. Railways, Collector of Bombay, Maharashtra Housing Board and Bombay Port Trust are represented on the Committee. Through this committee, adherence to the municipal policies laid down in respect of mosquito control, is ensured.

Control of Vector-Borne Diseases by Ecologically Safe Methods

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The World Health Organisation defines environmental sanitation as "the control of all those factors in man's physical environment which exercise or may exercise a deleterious effect on his physical development, health and survival"[1].

Environmental sanitation affects everyone alike. Everyone takes water and food, breathes air and wants to get rid of liquid and solid wastes and pests/vectors. If one person is affected by the degradation of the environment, everyone is likely to suffer to some extent. Therefore, environmental sanitation includes the provision of safe water, disposal of wastes, food hygiene and pest/vector control.

It is well-known that control of pest/vector is associated with general sanitation. Environmental sanitation measures are aimed at prevention of disease and promotion of health. Modern epidemiological methods are used to study the distribution and determinants of disease in human population with the ultimate aim of eradicating the disease. The need for integrated pest/vector control and epidemiological surveillance with full community participation has been well explained time and again[2-15].

For a public health administrator, a more explicit appreciation of the general functional framework which underlies organisational structure may help him make better plans and decisions. An attempt is, therefore, made to sketch a broad functional matrix for environmental public health organisation, to constitute a more effective integrated system.

Communities have their own internal structure, with distinct channels of influence and communication. The task of an external environmental health

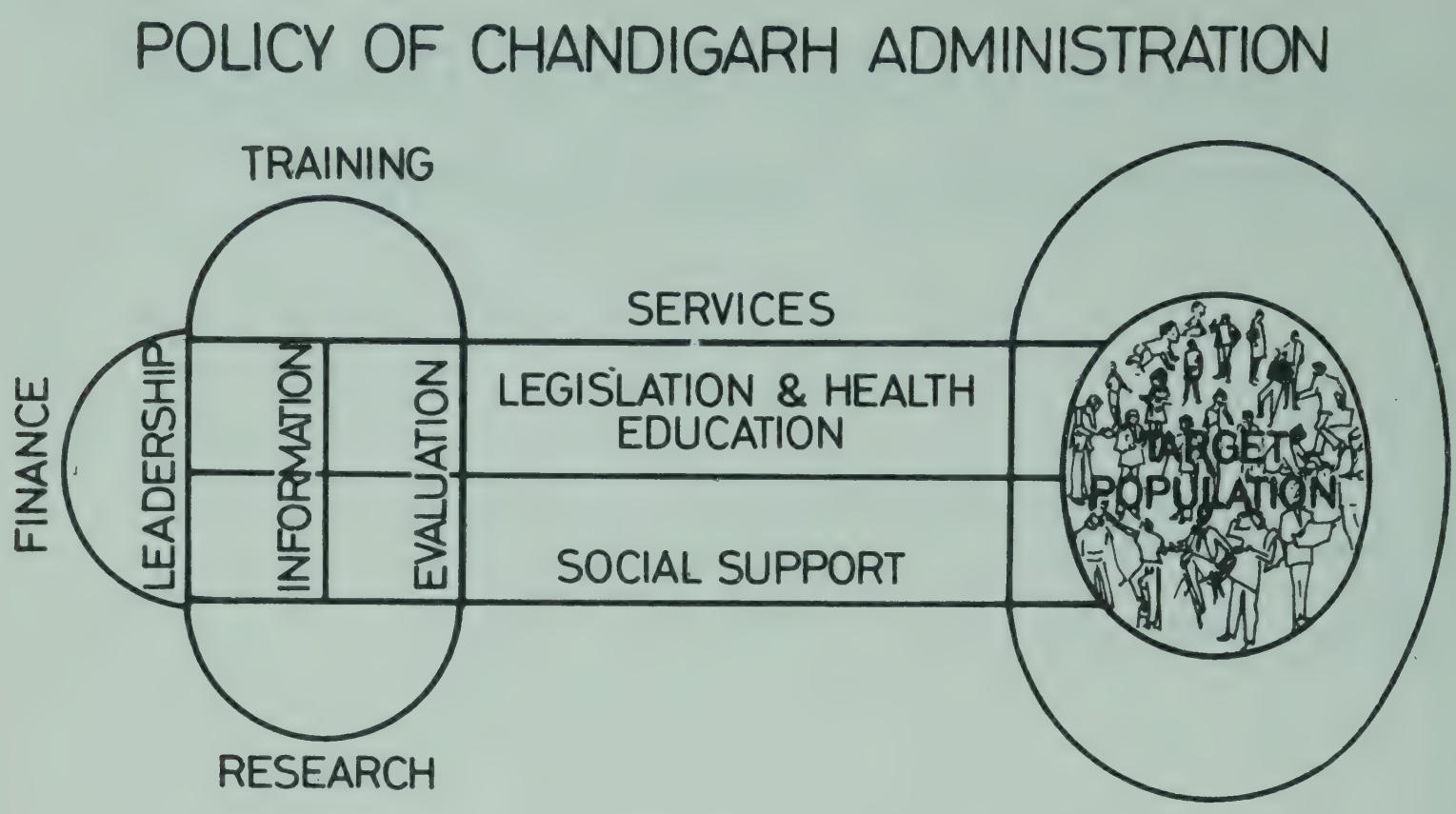


Fig. 1: Functional matrix of integrated environmental health system in Chandigarh.

programme structure is to engage the internal structure in such a way as to catalyse and mobilise forces within the population.

The Environmental Public Health Organisation structure shown in Fig. 1 looks like a key to solve human social problems. The force behind the key is the hand of public policy. The key itself contains nine lines, each line representing a functional element. These fall into three groups; (a) instrument functions, (b) control functions, and (c) supporting functions.

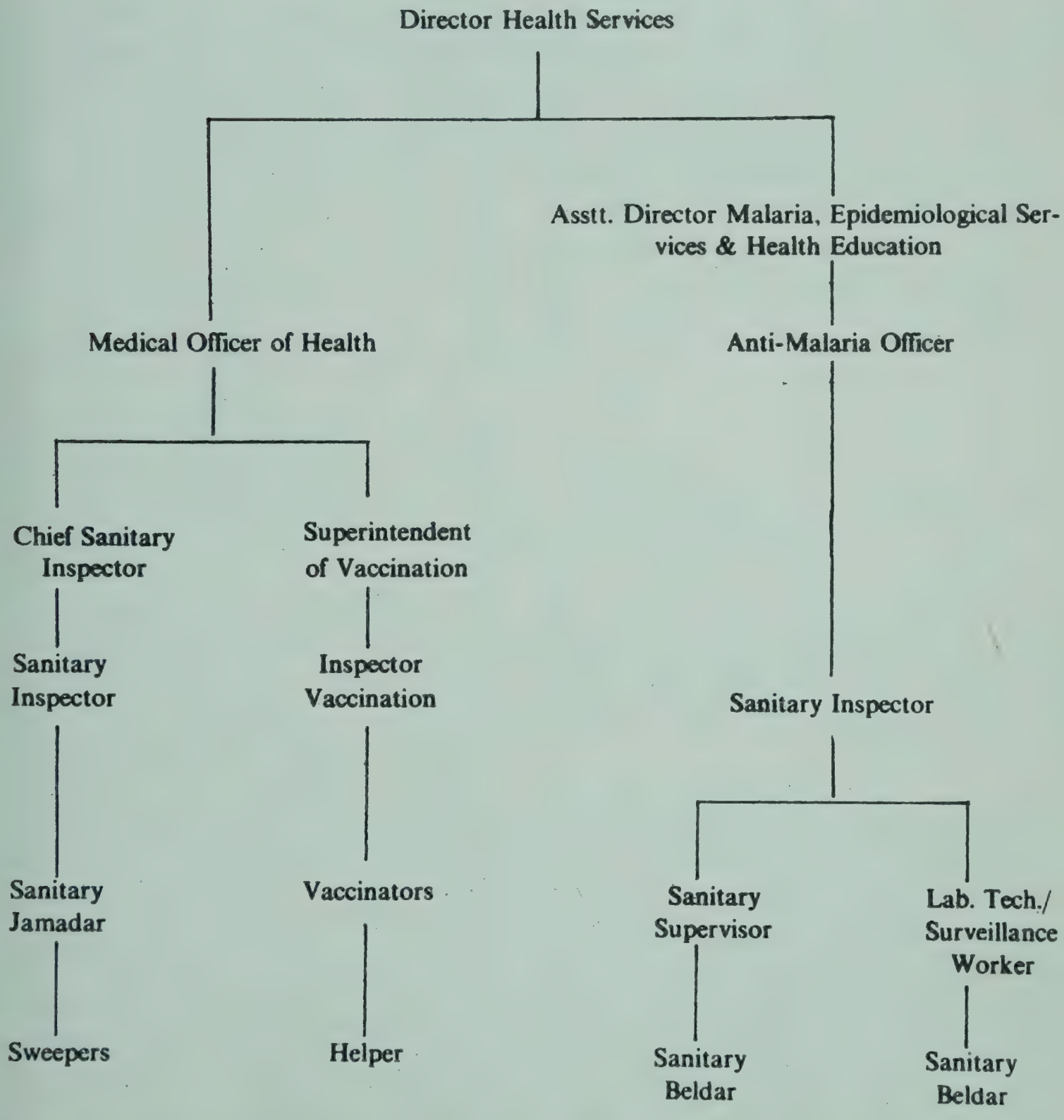
(a) *The instrument functions* are those which directly look into and activate the forces within the target population. (i) *Provision of integrated available and accessible services* to the public is of primary importance. (ii) *Legislation and Health Education*—modified human behaviour pattern could revolutionize environmental health. Legislation and health education are interdependent, one helps to promote the other. (iii) *Generating social support* without which people ignore legislation, health education and available services.

(b) *The Control functions* are to build, direct and coordinate the instrument functions. (iv) *Leadership* is needed to give supportive supervision and a strong direction to the programme and to elicit participation of other staff and to help identify and solve the problems in implementation. (v) *Information* is the very lifeline of any public health programme. At the centre/state/district/block level, it is vital in the planning, management and evaluation of this programme. (vi) *Evaluation* activities must provide the "feedback" information that the programme administrator needs, to monitor and improve the programme.

(c) *The supportive functions* feed into and sustain the control functions. (vii) *Training* of staff is needed to equip them for new possibilities with special arrangements for flexibility and for unusual types of needs. (viii) *Research* support is needed to provide new knowledge and to clarify problems arising as the programme advances. (ix) *Finance* and cash flow should be well distributed in order to ensure the smooth functioning of the programme.

INTERVENTION PROGRAMME

Chandigarh city has a population of 5,25,000 and an area of 114 sq kms. The Medical Officer of Health is in charge of general sanitation, food



Conservancy/scavenging, checking of quality of water supply, rabies control, food hygiene and epidemiological surveillance

Pest control (anti-larval)/anti-mosquito, anti-fly, anti-rat & general pest control), disinfection & epidemiological surveillance

Fig. 2: Disintegrated Services Organisational Chart

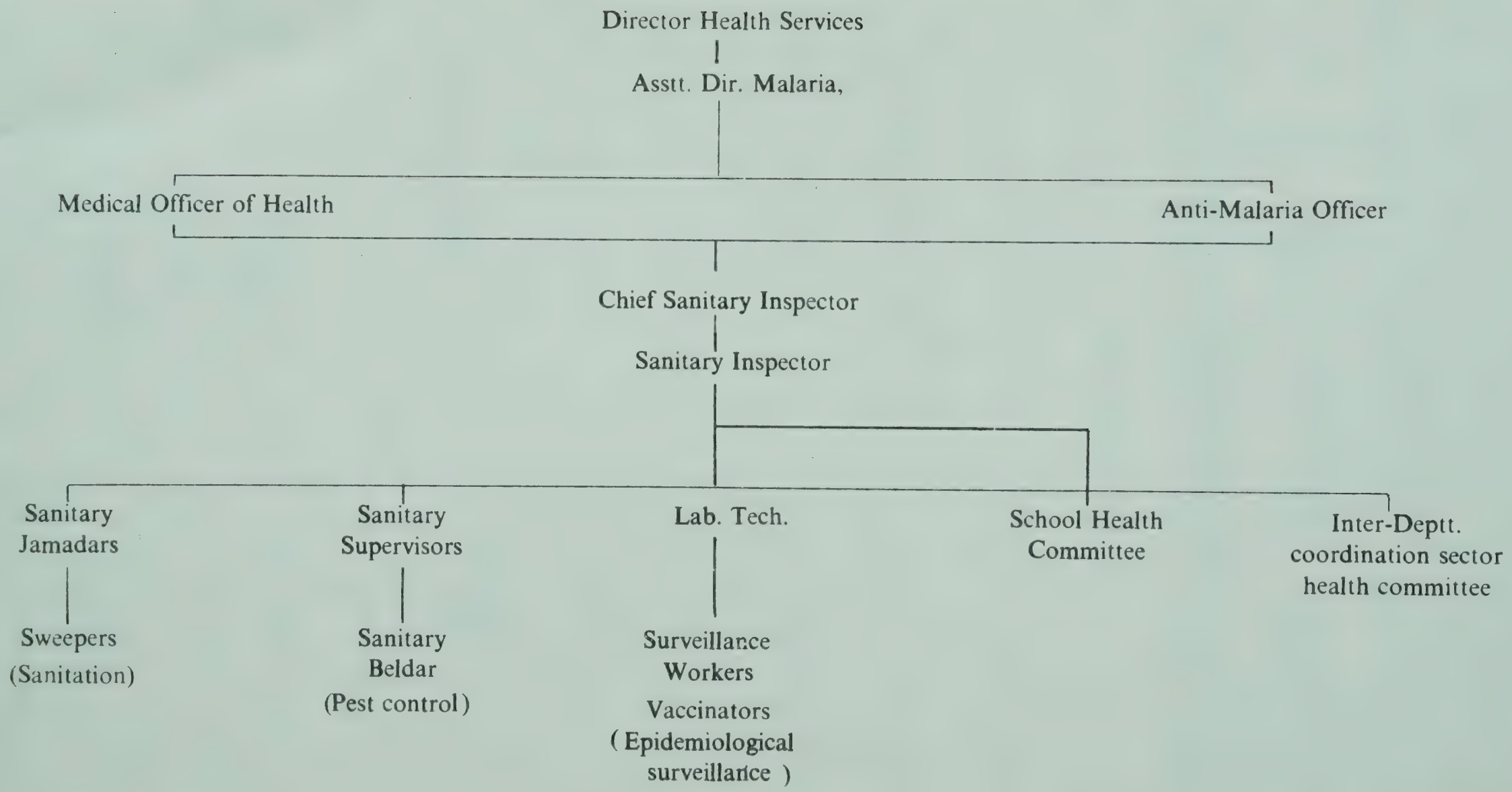


Fig. 3: Community based Sanitary-cum-epidemiological Stations (34).

hygiene and control of communicable diseases. The Biologist/Anti-malaria Officer is in charge of pest control and vector-borne diseases, etc. Both these organisations have been working separately. The organisational chart is shown in Fig. 2.

During early 1984, the Chandigarh Administration integrated various components of environmental sanitation, prevention and control of communicable diseases and health education (Fig. 3).

INSTRUMENT FUNCTIONS

1. Provision of integrated services

All the components of environmental health, prevention and control of communicable diseases and health education services have been integrated and decentralised at the local dispensaries/hospitals/Primary Health Centres. Thirty four sanitary-cum-epidemiological stations, each under the charge of one Sanitary Inspector have been established and equipped with modern equipment and stores. Their work is supervised by three Chief Sanitary Inspectors, Entomologist-cum-Parasitologist, Anti-Malaria Officer, Medical Officer of Health and Assistant Director of Malaria and Epidemiological services. The field operations (physical, biological and chemical etc.) are carried out in the same space and time.

2. Legislation and health education

All the Sanitary Inspectors, Chief Sanitary Inspectors, Superintendent Vaccination, Entomologist-cum-Parasitologist, Anti-Malaria Officer, Medical Officer of Health and Assistant Director, Epidemiological services and Health Education have been empowered under byelaws of the Punjab Municipal Act, 1911 and Chandigarh Environmental Health, Eradication of Malaria Regulations, 1981 and the Epidemic Act, 1897. A proposal for the establishment of a Mobile Court has been approved by the administration.

But all human problems cannot be tackled by regulations alone. Legislation is neither a permanent solution nor is it compatible with the system of democracy. Surely, health education tools are to be used in this direction. Health education was integrated at all the 34 Sanitary-cum-Epidemiological stations. Saturday is observed as Health Education day, in all the schools for about an hour. All the Sanitary Inspectors/Chief Sanitary Inspectors/Sanitary Supervisors have been allotted schools in their respective areas for this purpose.

3. Social support

For effective social support to the field programme, Environmental Health Committees consisting of officers from various departments i.e., Estates,

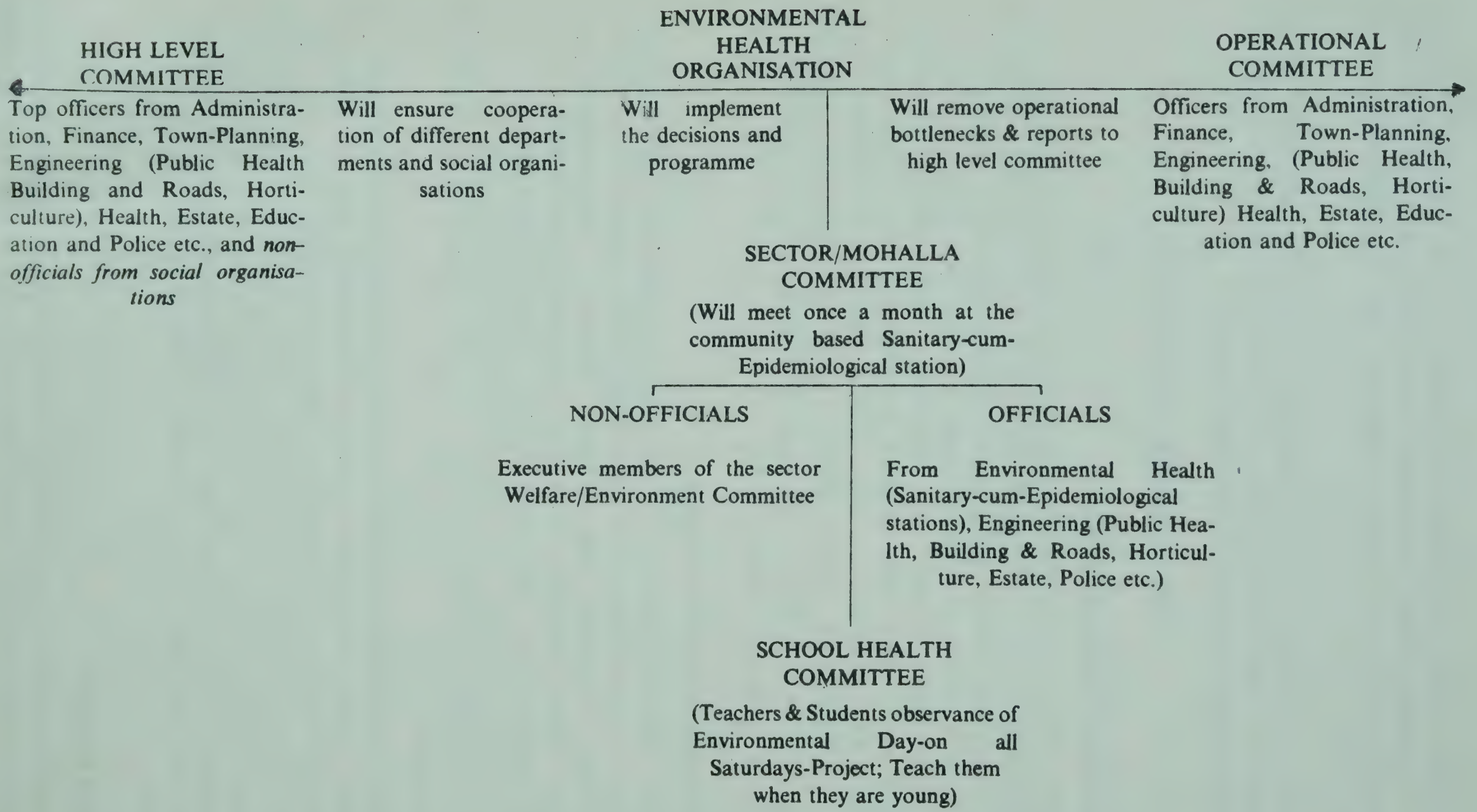

ENVIRONMENTAL HEALTH ORGANISATION
HIGH LEVEL COMMITTEE
Top officers from Administration, Finance, Town-Planning, Engineering (Public Health Building and Roads, Horticulture), Health, Estate, Education and Police etc., and non-officials from social organisations
Will ensure cooperation of different departments and social organisations
Will implement the decisions and programme
Will remove operational bottlenecks & reports to high level committee
OPERATIONAL COMMITTEE
Officers from Administration, Finance, Town-Planning, Engineering, (Public Health, Building & Roads, Horticulture) Health, Estate, Education and Police etc.
SECTOR/MOHALLA COMMITTEE
(Will meet once a month at the community based Sanitary-cum-Epidemiological station)
NON-OFFICIALS
Executive members of the sector Welfare/Environment Committee
OFFICIALS
From Environmental Health (Sanitary-cum-Epidemiological stations), Engineering (Public Health, Building & Roads, Horticulture, Estate, Police etc.)
SCHOOL HEALTH COMMITTEE
(Teachers & Students observance of Environmental Day-on all Saturdays-Project; Teach them when they are young)

Fig. 4: Functional chart of Environmental Health Organisation of the Health Department.

Horticulture, Building and Roads, Public Health, Engineering, Education, Health and Opinion leaders are being constituted at all the Sanitary-cum-Epidemiological stations (Fig. 4).

4. Leadership

At the state level, a high powered Environmental Health Committee under the chairmanship of the Chief Commissioner has been functioning to resolve the operational and administrative problems in the implementation of the field operations.

5. Information

The establishment of 34 Sanitary-cum-Epidemiological stations in various sectors attached to the local dispensaries/hospitals/Primary Health Centres has helped greatly in strengthening the epidemiological surveillance/ information system.

6. Evaluation

The environmental and epidemiological data collected from the Sanitary-cum-Epidemiological stations is refined and again transmitted to these stations so that the staff can evaluate their performance themselves. This has helped in identifying the weaknesses of the programme, which are then suitably rectified.

SUPPORTING FUNCTIONS

7. Training

All the Sanitary Inspectors in charge of Sanitary-cum-Epidemiological stations, have been given orientation traning in epidemiology and control of communicable diseases. A proposal to start B.Sc. (Environmental Sanitation/Public Health), approved by the Director, P.G.I., Chandigarh and Director, Health Services, Punjab, is under consideration by the Punjab University, Chandigarh.

8. Research

(i) A proposal for the establishment of a project "Malaria control by environmental methods" is under the consideration of Indian Council of Medical Research, New Delhi.

(ii) The Department of Parasitology, PGIMER, Chandigarh, in collaboration with this organisation has started Seroepidemiological studies on malaria (sponsored by ICMR, New Delhi).

9. Finance

The Chandigarh Administration has enhanced the powers of heads of office and DDOs under the financial regulations which has helped to identify the field operations.

Table 1. Mosquito breeding situations

Year	Building	Overhead tanks	Cistern	Water meter	S.V./ F.H.	Gully traps	Desert cooler/ A.C.	Ornamental tanks	Tyres	Tins	Depression ponds	Fire bucket	Coal tar drums	Tree holes/ cavity
1983	49060	48625 (7625)	73222 (3150)	55296 (2250)	2695	11357	6550	130	13669	6557	544	1038	6130	4753
1984	56846	50168 (7266)	85545 (2550)	65718 (1700)	2848	11745	8567	149	13750	6642	8881	6209	11003	3396
1985	73337	51004 (6486)	90550 (1234)	51979 (1269)	2938	11750	9649	230	6265	6885	3090	6237	12000	3394

Figures in parentheses show number of sites that are not mosquito proof.

Table 2. Entomological evaluation

Year	Mosquito breeding places checked	Positive for mosquito breeding			Percentage		No. of mosquitoes collected		Density	
		Total	Larval	Pupal	Larval	Pupal	A	C	A	C
1983	53,182	1818	1197	621	2.25	1.16	3515	11377	3.6	6.0
1984	64,733	2375	1806	569	2.78	0.87	3783	10458	2.2	6.8
1985	94,649	2220	1773	447	1.9	0.5	3730	13637	1.1	4.3

During 1984, only one *A. stephensi* was found positive for sporozoites.
A = *Anopheles*.
C = *Culex*.

DISCUSSION OF FIELD DATA

Table 1 shows that the mosquito breeding sources decreased [overhead tanks which are not mosquito proof 7625 (1983), 7266 (1984), and 6486 (1985), cisterns 3150 (1983), 2250 (1984), and 1234 (1985), water meters 2250 (1983), 1700 (1984), and 1269 (1985)]. This is due to environmental sanitation measures undertaken during the year 1984 and 1985.

Table 2 shows that the percentage of mosquito breeding (larval and pupal) stages also decreased from 2.7 (1984) to 1.9 (1985) and 0.87 (1984) to 0.5 (1985) respectively. Similarly, the mosquito density per man hour decreased from 3.6 (1983) to 2.2 (1984) and 1.1 (1985) for culicines, and 6.8 (1984) to 4.3 (1985) for anophelines. No anopheline mosquito was found positive during the year 1985. This is due to better coverage of the area by integrated environmental, chemical, biological and epidemiological measures in the same space and time during the year 1984-85.

Table 3 shows that ABER was 20.4 (1983), 19.3 (1984) and 29.6 (1985). The API increased from 44.8 (1984) to 66.2 (1985). This is due to increased collection of blood slides and better coverage of the area (99,427) in 1984 and

Table 3. Malaria epidemiological data

Year	B.S. Collected	Positive	ABER	API	SPR	Pf cases	SFR
1983	98422	21622	20.4	45.6	21.4	669	0.65
1984	99427	23102	19.3	44.8	23.2	1265	1.27
1985	155093	34765	29.6	66.2	22.4	607	0.39

1,55,093 (1985). But if we see the SPR, we find that there was a marginal decrease from 23.2 to 22.4 in 1985.

In Table 4, we find that the monthly incidence of malaria increased by 347.81 in April and declined month after month, especially during the transmission season. SfR decreased from 1.27 in 1984 to 0.39 in 1985. Most of these cases are imported from Punjab, Haryana, Uttar Pradesh and other states.

Table 5 shows that there was no case of death due to JE, kala-azar and plague during 1983, 35 in 1984 and 1985. There were 675 cases of DHF in 1983 , 35 in 1984 and 2 in 1985. Filaria incidence was 12 in 1983, 10 in 1984 and 8 in 1985. All these cases are imported from Kerala, Uttar Pradesh and Bihar. There is also a decline in the incidence of diarrhoeal diseases and dog bite cases.

The community based sanitary-cum-epidemiological services approach (integrated physical, biological, chemical and epidemiological) has helped in:

Table 4. Monthly comparison of malaria incidence, 1983–1985

Month	Total cases 1984	Total cases 1983	% age increase (+)/ decrease(−) as compared to 1983	Total cases 1985	Total cases 1984	% age increase(+) decrease(−) as compared to 1984
Jan	156	238	34.4(−)	369	156	136.5(+)
Feb	197	230	10.3(−)	377	197	91.3(+)
Mar	240	277	13.3(−)	590	240	145.8(+)
Apr	307	480	36.0(−)	1375	307	347.4(+)
May	769	1489	48.3(−)	3418	769	344.4(+)
Jun	1193	2190	45.6(−)	3933	1193	229.6(+)
Jul	2071	3018	31.3(−)	5681	2071	174.3(+)
Aug	6212	3246	91.3(+)	7422	6212	19.4(+)
Sep	6670	5755	15.8(+)	7267	6670	8.9(+)
Oct	3825	3328	14.9(+)	2957	3875	22.6(−)
Nov	1009	947	6.5(+)	956	1009	5.2(−)
Dec	453	418	8.3(+)	420	453	7.2(−)
Total	23102	21622	6.8(+)	34765	23102	50.4(+)

Table 5. Cases and deaths due to communicable diseases

Year	Population	JE		Filaria		DHF		Kala-azar		Plague	
		C	D	C	D	C	D	C	D	C	D
1983	4,50,000	—	—	12	—	675	—	—	—	—	—
1984	4,75,000	—	—	10	—	35	—	—	—	—	—
1985	5,25,000	—	—	8	—	2	—	—	—	—	—

C = Cases, D = Deaths, JE = Japanese Encephalitis, DHF = Dengue Haemorrhagic Fever.

—Reducing dependence on pesticides and chemicals by 15% as compared to 1984. This process will continue year after year. Thus, chemicals used in harmony with natural environment will help in controlling environmental pollution.

— Provision of available and accessible services to the community. This has reduced public complaints by 25% as compared to 1984.

—Eliciting community participation and inter-sectoral coordination by establishment of committees (official and non-official) at all the 34 sanitary-cum-epidemiological stations.

—Ensuring inter-sectoral coordination at the state level by the constitution of high level State Environmental Health Committees.

—Improving the information and evaluation system thus providing effective control over communicable diseases.

—Better utilisation of manpower and resources.

—Creating environmental health consciousness amongst the citizens.

Now that the WHO Expert Committee on Vector Biology and Control and the Government of India, Ministry of Health and Family Welfare, have also recommended an integrated systems approach[16,17] (community based sanitary-cum-epidemiological system), it is hoped that others will follow suit.

The community based sanitary-cum-epidemiological system in Chandigarh is still in an infant stage. But the lessons learnt here can be applied throughout the urban and rural areas in the developing and developed countries so as to achieve "Health for all by the year 2000".

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Guinea Worm Eradication—an Integrated Approach

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INTRODUCTION

Guinea Worm Disease or Dracunculiasis is endemic in 17 African states, sub Sahara, Saudi Arabia, Pakistan and India. It is often delimited to poor people in remote areas, however, the exact frequency is not known. Prevention of Guinea Worm is simple and yet difficult to implement in these areas. It is totally water-related and can be eradicated. A multi-disciplinary approach is recommended for a long-term solution.

Public health engineering measures like construction of water latrines, cattle troughs, washing platforms and reconstruction of stepwells where they are used should be coordinated with awareness building, orientation, training and education activities at all levels. The community should be involved, encouraged and trained to participate actively. A project including guinea worm control activities should be based on assessment of the felt needs of the population. Ideas and suggestions from the beneficiaries should be encouraged, planned and implemented. A plan of action outlining the order of activities to be implemented and responsibilities for participating ministries and organisations may be a useful instrument for implementation and monitoring purposes. During the implementation alternative or additional activities demanded by the beneficiaries or agreed with them might also be included in the project but gradually and in a planned manner in order not to lose concentration on the main objectives of the project.

Since people are suffering severely from guinea worm infestations there is an obvious felt need for its control which should be used as a soft entry point

for community participation. The community participation approach might then turn into other activities for improved health and hygiene-habits.

Locally made training materials have a greater effect in making people aware and helping them identify themselves with the messages. Traditional media should be used together with local institutions like non-government organizations (NGOs), scouts, school children, teachers, traditional birth attendants etc., in addition to the established health service.

Direct person-to-person contact is probably the best method for improving health and hygiene habits. Local women should be identified and trained to act as social animators at village level. They will be an important link between the beneficiaries and the project management strengthening the two-way communication necessary for people concerned in participation. They would also help in identifying and encouraging local women to participate actively in deciding the exact location of handpumps and other installations. This might improve the feeling of responsibility for better maintenance of the installations and their surroundings.

THE DISEASE

Guinea Worm Disease (GWD) or Dracunculiasis is a parasitic disease that develops in people who drink water containing a microscopic cyclop or water flea that has been infected by larvae of guinea worm. The cyclops are digested and killed by gastric juices in the stomach and the larvae penetrate the intestinal wall. The male and female worms mate some months after ingestion. The male worm dies and the gravid female worm lives in the connective tissue. After about eight months, the female worm often moves down to the lower limbs and ten to fourteen months after the infection, she is ready to emerge and reproduce. In doing so, she often produces secretions and toxic substances that eventually produce painful ulcers. The worm protrudes through the ulcer and when this is exposed to water, the larvae are released. Hundreds of thousands of larvae enter the water and thereby renew the entire cycle. The mature female worm is white, between $\frac{1}{2}$ and $1\frac{1}{2}$ metre long and 0.2 cms wide. All the larvae are not released at once. When the host enters water again, more larvae might be released. This process can be repeated a number of times. Guinea worm occurs in areas where the water surface temperatures are above 19°C. The disease occurs in a belt from West Africa, South of Sahara, over to East Africa, Middle East, Pakistan and India. Communities that depend on ponds, cisterns and stepwells for drinking water have the greatest risk of infection. Water becomes contaminated when people with guinea worm infection enter it, in order to collect drinking water or to take a bath.

There is no immunity against guinea worm, neither is there any effective treatment or prophylaxis. People in endemic areas might be reinfected year

after year. There is a marked seasonal recurrence depending upon the availability of water with infected cyclops. In India, the peak season interferes in many cases with the harvest season i.e., from April to September, although in areas where step-wells are frequently used as the water source, cases occur all the year around. The seasonalities are further associated with the yearly exposure to unsafe sources because safe sources dry out, larger quantities of water are consumed and there is a greater density of cyclops per unit of water

Guinea worm disease is in most cases not fatal, except when complication of tetanus occurs. Disability and heavy pains persist from time of blister formation until the expulsion of the worm, which takes on an average of one to two months. There are cases where permanent disability occurs, knee caps might be stiff or muscles at the lower part of the legs loose elasticity. In 80% of the cases, the worm emerges below the waist, however, it can emerge through the eyes, the arms or other parts of the body. Usually one worm emerges from the infected individual in a season, although there are cases in India where upto 15 worms have been detected in the same host.

No one knows how many people are infested by guinea worm each year in the world, estimations vary between 10 to 50 million. In India, more than 12 million people live in endemic villages and half a million cases of guinea worm disease occur annually. Around 12 million man-days are lost annually in India due to this disease. However, our intensive studies in the southern part of Rajasthan indicate that prevalence of the guinea worm disease is higher than what the official figures indicate.

Dracunculiasis is one of the oldest known diseases. In spite of that, this disease has been neglected for a long time. There are reasons for this. The importance of malaria, schistosomiasis and other global diseases have met much more attention. The guinea worm disease is seasonal and restricted to small isolated communities with poor people without political influence and low access to public health activities and transportation facilities. Infected villagers have very little incentive to seek treatment at dispensaries or hospitals since there are no effective drugs nor any vaccines to treat or prevent the disease. The real gravity of the guinea worm disease is, therefore, unknown. The methods of preventing guinea worm are simple. However, to organise an effective implementation of such prevention in remote rural areas is very complex. Prevention and control demand a multi-disciplinary approach involving the community. The tremendous pain and disability caused by this disease offers the best help for its eradication. There is an obvious need felt among suffering people to get rid of this drudgery. The disease is totally related to water. The infestation chain can thus easily be broken if the reconstruction of old water sources like stepwells and construction of new potable water sources is done in combination with awareness building and orientation activities involving the active participation of the community.

PROJECT PREPARATIONS

The project activities are concentrated to two districts, Banswara and Dungarpur in the southern part of Rajasthan. It is referred to as the Integrated Guinea Worm Control, Rural Water Supply, Health Education and Environmental Sanitation Project (IGEP). The project is thus intended to cover more than guinea worm eradication but guinea worm eradication should be an integrated part of this multi-purpose community participation project.

The project area covers a total of 8,800 sq km and the population comprises of some 1.8 million people. Most of them (75%) belong to scheduled tribes living in scattered habitations. In this area, famine is a regular phenomenon due to drought conditions, the literacy rate is extremely low and practically non-existent for women. A majority has poor access to means of production, a large part of the population is below the poverty line, the infant mortality rate is high, the health care is poor and most people are undernourished or in a state of acute malnutrition. Malaria, tuberculosis, diarrhoea, dysentery and skin diseases are prevalent.

Guinea worm disease is very common, Banswara and Dungarpur districts include 27% of all the 6,100 guinea worm villages in Rajasthan, or 11% of all the guinea worm infested villages in the whole of India. Water related diseases have since long been leading killers of infants and children in this area with poor unsanitary surroundings and an ignorant and poor population.

A tentative project plan was drawn up by UNICEF along with a cost estimate. This was discussed with the Government of Rajasthan on frequent occasions and approved in August 1985. In the meantime, UNICEF initiated a series of surveys which were carried out partly in association with local authorities. The first one was a hydrogeological survey which indicated good availability of potable water for the scattered population in the project areas. The next one was an assessment of the total needs and of the activities that can be carried out during the past five years. Thus, the number of stepwells to be converted, new water sources to be constructed and old water sources where the drainage should be improved were assessed along with the number of traditional birth attendants, school teachers, anganwadi workers, health guides and village social animators and other categories, to be trained.

A small sociological survey was also carried out in order to assess the needs of the local population. This was done through a series of discussions which were organised among local women, and village leaders. After some initial reluctance, many groups of tribal women willingly formulated their opinion of necessary actions which were taken into consideration when formulating the plan of action and when implementing the project activities. The result of the survey clearly indicates the real need for guinea worm control as the first priority followed by improved water supply and hygiene.

Furthermore, a baseline study is presently being carried out and will be presented shortly. It focusses on the socio-economic characteristics, water related health issues and community-cum-domestic sanitation. It will identify key indicators for the monitoring of project activities and form a basis for later impact assessments and evaluations.

As a result, a detailed and integrated plan of action of all the activities in this project has been elaborated by UNICEF in close cooperation with the Government of Rajasthan (from state to block level). A great number of concerned people have been involved in this process of discussions, collection of information and formulation of strategies during the last four months, following guidelines and strategy examples laid down by UNICEF. The evolvement of this plan of action has in itself served as a training process for people later to be involved in the implementation as well as the monitoring of the project.

I want to underline that the response from the population itself during this planning period has been very encouraging. More than 40 medical camps have already been carried out and about the same number of stepwells have been reconstructed entirely by the local authorities and people. More than 400 meetings have been held by UNICEF and district authorities with school children, teachers, local village leaders and other potential resource persons. An estimated 10,000 people have been participating in these meetings so far.

Regarding replicability, the Government of Rajasthan has, upon UNICEF's presentation of this project, decided to adopt the same approach and to use it in all remaining 11 guinea worm infested districts in Rajasthan. This is a major dent since this state comprises 50% of all infestations in India. In neighbouring Udaipur district preparation of a similar programme has already started utilising indigenous resources.

This project forms a part of the Master Plan of Operations agreed to between the Government of India and UNICEF.

OBJECTIVES

The main objective of the project is to improve health and living conditions of the population through:

—Alleviation of the drudgery of rural women and children by reducing time and effort to draw water;

—Control of the guinea worm infestation;

—Improvement of awareness and hygiene habits; and

—Convergence of water and sanitation activities with other ongoing development programmes.

STRATEGY

Besides the traditional elements of public health engineering measures, the project will emphasize on other activities considered as key elements for improved environment and economic development. The project will concentrate on hygiene education through different channels like schools, health institutions and anganwadi centres. Massive involvement of all possible partners will be encouraged and together with teachers, guides, para-medical workers and traditional birth attendants, actions will be started for closer cooperation with selected NGOs which will be entrusted in the daily work for inculcating the ideas of need for changing of habits and improved personal hygiene and environmental sanitation. The rural communities themselves will actively participate in the process of improvement of environmental conditions through sharing of decision making and responsibilities. Convergence of basic services will be made with other ongoing and planned projects in the area such as the Women's Development Project (WDP), the Social Inputs in Area Development (SIAD) and the Integrated Child Development Services (ICDS). Planning, implementation and monitoring will be coordinated with these projects in common steering and coordinating committees on state and district levels together with the Government comprising inputs, outputs, end-use and impact assessments through repeated review meetings in these committees, reports and systematic spot surveys based on a base line survey. The project will be reviewed annually.

To achieve these objectives, the following activities would be deployed:

1. Provision of potable water

—Augmentation of potable water supply by installation of additional 4,000 handpumps through the agencies of the Public Health Engineering Department (PHED) and Ground Water Department.
—Improving the existing facilities for handpump repairs.

2. Promoting behavioural change in health and sanitary habits

—Creation of awareness through health campaigns, exhibitions, cultural shows, camps and walks.
—Using traditional congregations of people for conveying the message of health, hygiene and sanitation through the use of rural media.
—Education and training through social animators, teachers, opinion leaders and other functionaries/agencies working in rural areas.

3. Control of guinea worm disease by breaking the chain of propagation

—Community education regarding prevention of guinea worm infections.
—Conversion of 2,700 stepwells into draw wells and thereby preventing contamination of drinking water by guinea worm patients.

—Provision of potable water by installation of 4,000 additional handpumps.
—Chemical treatment of infected water.
—Distribution of double coloured filter cloth for straining drinking water.
—Introduction of certain fish species in wells for cyclop control.
—Extraction of guinea worm in preventive and curative camps.

4. Improving environmental sanitation

—Community education and participation.
—Construction of cattle troughs and washing platforms (1,000 each) near sanitary wells and handpumps.
—Construction of institutional latrines (500).
—Construction of soak pits and drainage systems and plantation of trees near handpumps for better sanitation.

THE APPROACH

The project strategy emphasizes an integrated approach between the major components and involvement of the beneficiaries. Major stress would be on community mobilisation and participation, awareness building and training activities which will be the focal point in the implementation. Changes in habits and behaviour are usually brought about over a long period of time. It is thus imperative to involve the whole community in the awareness making process already from the start of the project activities. The software i.e., awareness making, orientation and training will thus be the most important part of the whole project and will also be the most difficult one.

From our project preparations we know that people are extremely interested in getting rid of the guinea worm infestation. We also know that they are willing to contribute actively to be free of this menace. Guinea worm eradication is thus an ideal entry point for training in community participation and creation of an awareness that active and concerned involvement from the community itself will improve water related habits, environmental and personal sanitation behaviour and other essential factors related to their own health situation. The method of concerned participation by the whole community which will be created by the guinea worm eradication campaign, should later on be used for achieving the other objectives of this multi-purpose community participation project.

The first major activity in this project will, therefore, be eradication of guinea worm. This will be done through a massive awareness making campaign throughout all the twelve blocks in this project area which will go hand-in-hand with the reconstruction of the 2,700 stepwells and provision of potable water while construction of latrines for instance will be started a little later when a public demand has been created. The reconstruction will be done

by the local people themselves, supported by the Block Development Officers. (During the preparatory stage a pilot reconstruction activity was launched showing that this can be done locally with a sufficient degree of quality. The costs, earlier estimated by PHED as Rs. 25,000–Rs. 50,000 per well, will thereby be reduced to an average cost of Rs. 5,000).

The wells which are very different in size and structure will be reconstructed into sanitary puller wells. The entrance to the water will thus be blocked either by a wall or by taking away the steps in the well and a parapet wall will be constructed along with a simpler puller arrangement. The wells will then be dried and cleaned and filled with fresh water. Chemical treatment will be done through the health department as a temporary measure awaiting reconstruction, which will be done in certain priority order determined by the frequency of guinea worm infestation. Closing of these wells is not possible because people need the water also for irrigation purposes. These activities will be combined with construction of new water sources by drilling and installation of India Mark-II deepwell handpumps near the existing stepwells. People will thereby have access both to their old traditional and socially accepted well and to a new well with safe water all the year round. (This combination might be necessary since the acceptance of water from deepwell handpumps in India is good but not total. Some 40% of people in India who have access to deepwell handpumps do not use them. The reasons are that they are new and people are not used to the taste of the water which they think is 'salty' in comparison with the sweet water in the open well). The reconstruction will be coordinated with a huge awareness making campaign. This aims at making people understand why and how they get infested and how to avoid it in the future.

Upon the formal inauguration of the project there will be a Village Contact Drive organised and carried out by 120 Village Contact Teams (VCTs). Between themselves they will cover every village in the project. They will camp in the villages for one day and one night. This stay should allow them to establish informal contact with the villagers which will, in turn, help them in conveying the composite message of health, hygiene and environmental sanitation. The teams will hold cultural programmes in the evening. They should involve local people for role plays focusing on the health, environmental sanitation and hygiene, including guinea worm problems. During their stay in the village, they will also collect basic information about the prevalence of diseases in endemic form, state of medical cover, sources of drinking water, names of guinea worm patients, etc. This will allow the project staff, to subsequently prepare a health inventory of the village which would add to the information collected through the baseline study. The VCT will consist of five persons including two female social animators recruited from the local community. The village level worker will be convenor of the team.

The project aims at having one female social animator for every Panchayat circle. It will thus be necessary to identify a total of 360 social animators. The

social animators will reinforce the knowledge of health and environmental sanitation through personal contact after the Village Contact Team has gone. They will provide the organic link at the local level between the project staff, block staff and the community. The social animators will be encouraged to listen to views expressed by the beneficiaries, discuss these and forward suggestions to the project staff. This will be a continuous process for safeguarding the bottom to top approach which should be advocated. They would also help in identifying community preferred locations for drilling of handpumps which will encourage the female users to engage themselves in a better maintenance of the pump and its surroundings.

Training and orientation will be imparted to all personnel involved in the execution of the project either directly or indirectly from officials at regional and district level, project staff, members of village contact teams and their trainees, to block development officers, extension officers and to female social animators. Local institutions and NGOs will contribute in this training/orientation effort following the plan laid down at a Workshop organised by UNICEF in December 1985.

Training and publicity material required for the project will be developed. Posters, charts, film strips, video film and 16mm film will be made for conveying the project message. Traditional folk media will be used in creating community awareness about health, hygiene, guinea worm control and environmental sanitation. This will involve use of puppets, various forms of local dances, devotional songs, etc. Suitable slogans will be developed for use by the project staff, teachers, VCTs, community members and others for popularising the project concept and plan. A separate group has been constituted for providing guidance on development of such material. Seminars and workshops on health, hygiene and sanitation will be organised during the project period.

The Village Contact Teams will be given a training kit (containing magnifying glass, double coloured filter cloth, posters and photographs for exhibition, folding blackboard made of cloth, water bottle, publicity material and material for use in the evening cultural programmes).

The school children will be imparted education in health, hygiene and sanitation including prevention of guinea worm through their teachers. This will be done either during the school assembly or in classes twice a week during the first month of launching the village contact drive. This will allow reinforcement of message to adults through the school children talking about the health related problems including the guinea worm disease to their family members.

The school teachers will be given posters, pamphlets and some other teaching material. They will be formally trained in communicating the project message to their students. The primary school teachers (2,500) will be reached at the pay distribution camps (48). The teachers of upper primary secondary

and higher secondary schools will be given half-day orientation at their schools. The agency of District Education Officer will be used for organising health education of school going children.

Anganwadi workers and village health guides numbering about 150/block will also be given orientation in health education in one-day programme to be organised every year. The training will be imparted by the project personnel.

Production of double coloured filter cloth has already started through the assistance of two local NGOs and the utilisation of this method for filtering of the water will be advocated.

For treating guinea worm infected patients, preventive and curative camps will be organised in those villages where incidence of guinea worm is high. In these camps, guinea worm will be extracted by trained team of Ayurved practitioners and post-extraction care will be provided. The patients and attendants will at the same time be educated regarding control of guinea worm disease, hygiene education and environmental sanitation. Films and photographic exhibitions produced locally will be used and double coloured filter cloths will be distributed during these camps. It is estimated that there are about 3,500 guinea worm patients in Dungarpur district and about 1,000 patients in Banswara district presently. In 1985–86, 50 curative and preventive camps will be held (including those already held) while 70 camps each will be organised in 1986–87 and 1987–88. Due to reduced incidence of guinea worm disease in later phase of the project, 25 camps will be required in 1988–89 and 15 camps in 1989–90.

In coordinating the different ministries and departments involved, a District Project Implementation Committee will be established in each district under the Chairmanship of the District Collectors. A number of responsible persons from these ministries will, together with the project staff, have monthly meetings in order to overview, monitor and improve the implementation of the project. On the state level, there will be a Committee of Directions holding quarterly meetings thereby monitoring and overviewing the project activities at large, keeping proper contact and information with the Government of Rajasthan in Jaipur. Since the members of these Committees either work within other ongoing projects or have a responsibility to their implementation convergence between these projects and IGEP will be facilitated. Additional activities for improved health and sanitation initiated by the beneficiaries may also be discussed. The project staff employed, on full time basis, will have authority to conduct, control and implement all the project activities involving functionaries from different departments in the project area like PHED Tribal Regional Development Department (TRD), medical department, social welfare, education etc. The project staff should also be requested to stimulate, discuss and report about ideas regarding alternative and additional activities expressed by the villagers. The project personnel and the project management will be guided by the integrated plan of action which we have discussed above.

There will be an annual review of the project. Thereby, new or alternative activities for health and sanitary improvement based on local needs and preferences may be included.

RECOMMENDATIONS

It is, of course, difficult to draw any conclusions on the outcome of this project before it has started. However, the planning period has clearly indicated some points of view which might be considered for use elsewhere.

—Wherever a rural water programme is going on, it should include a guinea worm control component in the infested areas. Awareness-building, orientation and health education should form the most essential part of this component along with necessary environmental engineering activities. To control guinea worm disease without supplying potable water is probably impossible as a long term solution. Vector control in terms of pouring chemicals, be it superchlorination or Temephos (Abate), into the water should be regarded as a temporary measure at least in areas where stepwells are used. In these areas reconstruction of the stepwells into sanitary puller wells is recommended. There are at least six guinea worm infested states in India. As you might know, India has embarked upon a huge nationwide rural water and sanitation programme assisted by UNICEF and other organisations. Nearly one million standardised Indian Mark-II deepwell handpumps have been installed on drilled boreholes throughout the country including these six states. UNICEF will continue its support to this rural water and environmental sanitation project according to a five year Master Plan of Operations agreed to between the Government of India and UNICEF. The possibility of the inclusion of guinea worm control activities in the continued rural water programme in these six states will be explored. Methods to be used in this IGEP project might thus be replicated elsewhere.

—Wherever guinea worm infection exists, it can probably be used as the entry point in order to develop a habit of community participation as a method for the people concerned to solving their own problems. This is due to the obvious felt need people have for eradicating the drudgery of guinea worm. By including guinea worm control activities in the rural water and sanitation programme it might be easier to motivate people to work together to achieve different objectives starting with guinea worm control as the entry point and later continue with for instance health education or other tasks necessary to improve people's personal hygiene and environmental sanitation habits.

—In order to replicate the approach and some of the methods used in the IGEP project, it is essential to emphasize awareness-building, orien-

tation, health education and community participation as a method. But it is also important for replication to keep the costs as low as possible. Many so called pilot projects have not been able to replicate due to lack of resources when going to scale. We have, therefore, strived towards a local contribution to the extent possible. Reconstruction of stepwells will thus be done by local masons and villagers. Weaving and stitching of double coloured water filters will be done locally by NGOs and groups of women. Latrines, cattle troughs and washing platforms will also be constructed at village and block level. Only drilling of boreholes and installation of handpumps will be done by non-local bodies, in this case the Public Health Engineering Department. On the other hand, drilling and handpump installation is something which will be done anyway within the ongoing rural water and environmental sanitation programme, so this will not be an additional cost for respective state governments.

—The activities involved should be planned so the software part, like awareness-building, orientation and training goes hand-in-hand with reconstruction of stepwells, drilling and installation of handpumps, construction of latrines, cattle troughs, washing platforms (or whatever activities are to be chosen in the specific case). It is essential to create a feeling among the villagers themselves of ownership and willingness to carry out maintenance and repair on installed equipment. Rural women should, for example, participate actively in decision-making regarding the exact location of the handpumps and other installations, since they are the main users.

—India has embarked upon a nationwide so called guinea worm eradication programme. Within that programme a continued semi-annual assessment of guinea worm infestations is done and the result is presented in reports from the endemic states as well as in a summary from the National Institute of Communicable Diseases. This is excellent and constitutes a great help when planning guinea worm eradication programmes. For reasons mentioned earlier it is extremely difficult to detect all cases in the remote areas where infestations prevail. When planning guinea worm eradication activities, it is, therefore, recommended to make a specific assessment on the spot about the frequency of infestations in addition to the statistics available from the above programme. The migration pattern in the area is also of interest and should be mapped out if possible, since visitors might reinfect a whole area very quickly. When making up priority lists for water wells to be reconstructed, it is, therefore, important to start with those close to roads and other areas usually used for transport.

—Involving the whole population in the guinea worm control project is important. In doing so, one should strive at making all feasible training materials, from posters and stickers to films, theatre, puppet shows, etc.,

on the local level with the local population participating to the extent possible. People should be able to recognise their own situation in what they see, be it on a little theatre floor, a poster or a film screen. Photographic exhibitions with complementary text should thus contain pictures taken from the same area. Manuscripts for theatre groups and puppet shows should be developed together with people from the area itself. Video films or 16 mm films should be shot locally. To use mass media, be it radio or T.V. without follow-up activities on the village level is not to be recommended.

—However, important materials might be, person-to-person contact is probably the most efficient method of improving health habits, to identify local women and men with a good reputation in the villages and to train them into social animators is probably one of the most important methods of creating better health standards and habits. This takes a lot of time and spadework but it is certainly worth it in the long run. To concentrate only on the existing health services is normally not enough for achieving a total coverage. Unfortunately, these services do not reach the poorest people in the most remote areas. Therefore, to identify and train resource persons well known to the beneficiaries like traditional birth attendants, school teachers, anganwadi workers, village leaders etc., is essential. Another important category is of course mothers. If they can be identified and trained (by the social animators) they are probably most suitable for imparting improved health habits among the children. Besides, training of mothers often gives much better results than training of any other categories; also with regard to other aspects such as education, income generating activities etc.

The summarised strategy for controlling the guinea worm infestations, I would recommend, includes both immediate corrective activities and long term preventive solutions. The following activities may be included in such a strategy for guinea worm control:

1. Conversion of stepwells into sanitary wells using local manpower to the extent possible. This might include a new platform, parapet wall and treatment of water like dewaterisation, digging, cleaning of mud and possible chlorination. The stepwell conversion where these exist should be taken as immediate priority, firstly to control the transmission of cyclops and secondly, to make this traditional water source a safe one.

   —To achieve these two immediate objectives, a massive campaign can be launched that should involve practically all the governmental and non-governmental agencies functioning at village level. All the relevant district departments should be approached and the project activities should be shared and reviewed with them so that no communication lapses remain in assuring full support, help and cooperation from the district level authorities.

—The next step might be group meetings to be held in all the blocks and at village level. Concentration should be given initially to those villages which are identified as badly affected areas. The village and hamlet level group meetings should be organised under the leadership of the respective village leader and emphasis should be given to mobilise the young children, women, traditional birth attendants, health workers, ICDS workers, primary school teachers, non-formal and adult education instructors and community functionaries etc. The approach of such a campaign should be direct.

—These meetings should be supplemented by organising medical camps right at the village level to treat the guinea worm patients together with information from film shows or photo exhibitions in order to emphasize how people can prevent themselves from further guinea worm infestations.

—Double coloured water filters can also be distributed at such medical camps. The community opinion will eventually be formed in favour of conversion of stepwells. Basic aspects of health education like filtration of water, water management and social sanitation against guinea worm patients entering into the stepwells should be the main objectives to disseminate through the campaign programme.

2. Intensive and simultaneous awareness campaigns, promoting health, social and improved water related habits, training of motivators and advocacy for people's own participation in the project activities.
3. Provision of package sanitary programme for improving environmental sanitation including improved drainage, construction of soakpits, cattle troughs and latrines.
4. Provision of trained manpower at village level for managing and sustaining the project benefits.
5. Provision of new safe water sources through installation of handpumps close to stepwells, institutions like schools, health centres and anganwadi centres and in remote areas and habitations where people do not have access to potable water.

ACKNOWLEDGEMENTS

I am grateful for the opportunity I have been given to inform about the strategy and methods to be used in a project which UNICEF has planned together with the Government of Rajasthan. The project will be sponsored by the Swedish International Development Authority, SIDA, through UNICEF and its first phase of five years has started with one year of preparations. The total cost for this phase is budgeted to $ 10 million of which the Government of Rajasthan will cover 40% and UNICEF 60%.

Vector control at Community level in Africa

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INTRODUCTION

Vector control Policies and Strategies

"The strategy of Health for All by the year 2000 made a broad appeal for the participation of communities in primary health care (PHC), one element of which was protection against vector-borne disease"[1].

A study group on malaria control in 1984 has underlined the need to transfer as much as possible of the malaria vector control activities to PHC systems[2]. The policy of PHC development is intended to bring about a gradual shift to the communities of the responsibility for implementing vector control measures for which they are technologically apt.

This policy does not spell the end of vertical programmes which will continue to carry out operations calling for substantial technologies which are beyond the means of the population and even the local government bodies. Yet it does call for harmonization of the two types of activities.

A paragraph of the Declaration of Alma Ata (1978) quoted by the 7th Asian Malaria Conference[3] defines this approach as "The support of other levels of the health system is necessary to ensure that people enjoy benefits of valid and useful technical knowledge that is too complex or costly to apply routinely through primary health care services."

The Onchocerciasis Control Programme in the Volta River Basin, in West Africa funded by more than 20 donor countries and agencies fulfills these

criteria. As there is no drug available against the parasite it is based on the blackfly vector control by aerial treatments of 17,000 km of river with insecticide, covering 7,64,000 km² in seven countries (Benin, Burkina Faso, Ghana, Ivory Coast, Mali, Niger, Togo). None of these endemic countries has enough resources and technical expertise to undertake such treatments on its own territory. Moreover operations should be planned and implemented on a regional basis due to the long-range flying vector *Simulium damnosum s.l.* [4]

The improvement of technologic capabilities at peripheral level and the development of new appropriate methods and tools of control should give increasing importance to community activities.

Vector control at community level involves integrating different techniques while blending with overall health activities and the development process. For instance, *Anopheles* control may combine house spraying with various antilarval measures and self protection devices e.g., bed nets. However, vector control is merely one aspect of malaria control which can also be combined with effective drugs. This raises the question of the priority of vector control with regard to therapy. Strictly speaking, the two fronts on which the disease is to be fought should be complementary. In actual fact, there is some danger that they may compete with one another in countries where the health budget is very slim, as is the case in most African states. Throughout the African Region at present, drugs are being used in preference to burdensome vector control measures because they are more consistent with the methods presently in use in PHC.

The process of technical, administrative and geographic decentralization will strongly influence vector control as well as disease control strategies. Large-scale activities based on standardized methods will be replaced by activities of a more restricted nature worked out in terms of local health priorities and planned in such a way as to use all available local resources to control one or more diseases.

IMPLEMENTATION AND SUPPORT STRUCTURES

Basic structures

The community is involved at least at three levels in vector control. All its members are concerned in domestic and peridomestic sanitation measures and in their self-protection e.g., by use of bed nets, during a limited period of time or permanently. Vector control also calls for mastery of a number of techniques and, accordingly, specialisation of workers is needed to enable them not only to carry out the required work but also to act as guides to other community members. Whether these workers are agents of the community or of peripheral health services depends on the socio-political organization of the community. They need some kind of remuneration as goodwill may otherwise be difficult to sustain [5]. These agents should in particular explain the objectives

and benefits expected from each type of activity and clearly delineate each one's responsibility and the duration of the operations. Work involving engineering e.g., filling marshes to reduce vector breeding sources, involve large groups of people for a limited period of time.

Community representatives should also be kept properly informed and should be involved in decision making regarding each activity, assessing the latter's acceptability for their fellow members and in participating in the planning.

Urban periphery populations have broadly similar problems. Very often the inhabitants are overlooked by the health and municipal services whose collaboration is essential for vector control activity involving environmental sanitation. However, the surroundings in which such communities, composed mainly of recent immigrants without their traditional organization, actually live are poorly developed and the infrastructure is less than the minimum standard for proper sanitation. Municipal services overworked by the fast growth of the population are not able to bring significant help to the communities for controlling vectors through building and maintaining drains, removing garbage, etc., as to solve most of their social problems.

Even though the process started later than in other continents uncontrolled urbanization is now becoming very acute in Africa where it is expected that more than 33% of the population will be urbanized by the year 2000.

Support, evaluation and research structures

Community agents or peripheral health services workers have generally limited technical background and they lack resources. Their activities should, therefore, receive operational support at district level, and scientific and technical guidance at national or provincial level[6].

Operational support should consist first of:—

—Training workers and maintaining the standards acquired during the training.
—Providing them with all necessary information and involving them in the evaluation of operations to sustain their interest.
—Advising and supervising the work.
—Finally, above all providing workers with whatever material and logistic means they require.

At national level, a top level inter-disciplinary nucleus should be formed to carry out the following tasks.

—Identify health priorities for each region and make a proper stratification of the diseases for each region.
—Decide on methods of operation for each disease in a multidisease control system.

—Carefully select the techniques to be employed, singly and integrated, in each region and even in each particular situation.
—Break down into their fundamental components the activities to be carried out by peripheral workers.
—Evaluate the results.
—Plan the intersectoral activities.
—Provide in-service training for middle level and junior workers.

These tasks, to be successfully carried out, call for an expertise and epidemiological background that most countries in Africa are far from possessing. It is, therefore, important that necessary research be conducted in order to make up for shortcomings and to improve the machinery of vector control. Reaching beyond the bounds of entomology, it takes in the other sciences, medicine demography, sociology, economics and agriculture. This inter-disciplinary approach goes hand-in-hand with integration of vector control as much into health improving activitites as into socio-economic development.

It should also be pointed out that the cost of vector control, even with community participation will be high; purchase of pesticides, spraying equipment, traps, and control supplies, servicing of equipment and possibly vehicles, and salaries whenever voluntary funds cannot cover needs. To this should be added the cost of salaries and expenses of support teams, particularly of medical entomologists and entomological technicians. In the cost/benefit analysis arises the question of taking into account or not the volunteer work done by community members.

Vector control at community level will have no real impact unless it is provided with appropriate facilities, staff and tools of operation, without these as basics, it will be makeshift and ineffective.

We recall these operational, technical and scientific constraints because in most African countries, scientific and operational support is not yet strong enough considering the enormous tasks of vector-borne disease control. In addition to training qualified personnel of different levels, a proper organization can only be built if there is a political willingness to do so. Health authorities should be taught that vector control even with the magic of community participation is not simple and requires financial involvement.

CULTURAL, SOCIAL AND ECONOMIC FRAMEWORK FOR COMMUNITY PARTICIPATION

The rural and urban populations, though benefiting from vector control, have mostly been passive spectators often uninformed of the aims of the operations. Their collaboration was often asked, e.g., for environmental sanitation through compulsory sanitary regulations. Such an approach which

is not always effective, does not encourage community involvement, although in some cases it may contribute to implementing health measures.

The people should turn into agents of vector control. At first they should be kept informed of the aims of any operation before it is undertaken and of its results when it is in progress. But community participation can be sustained only if the community members feel the beneficial effects of the activities in which they are involved and if constraints are compatible with their way of life and their economic capabilities.

Perception of the role of vectors

It was only at the end of the 19th century that the role of insects in the transmission of diseases was discovered. It followed the advances of modern science and the discovery of infective agents.

The perception of disease was part of the philosophical system of society elaborated far before the discoveries of modern western science. In many African cultures as in the Congo for example, disease was not an entity but a particular condition of man often attributed to conflict with his environment or to magical practices*.

The present perception of disease and of the role of vectors is a compromise between traditional concepts and the input of western culture[7]. For example in the Congo and the Niari district, between 1910 and 1940, sleeping sickness became highly prevalent and inflicted high mortality. Its efficient control was due to strong medical action, the basic structures of which are still functioning. The disease is identified and called "nberre tolo" and the role of tsetse flies is known to everybody. Tsetse control by trapping is not only welcomed but requested by the people. A project based on community participation has just been implemented[8]. On the borders of the endemic foci where the disease was less severe its perception is unclear and, if transmission by vectors is generally accepted, all kinds of biting insects are incriminated.

Sleeping sickness epidemics of the first half of this century are still vivid in the collective memory in Burkina Faso in West Africa. Some valleys like the Black Volta infested by tsetse flies are considered to be evil in spite of the absence of new cases during the last 20 years.

In Guinea some people consider onchocerciasis blindness to be caused by the blood of engorged blackflies squashed on the face when biting. Such an interpretation may be recent and results in misunderstanding of the scientific explanation.

The linkage between blindness caused by onchocerciasis and rivers has been commonly established in Africa even for those who did not know the patterns

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*Information dealing with the Congo has been given by F. Hagenbucher, ORSTOM Anthropologist.

of disease transmission. In savanna areas of West Africa, villages were deserted when the blindness rate was up to 10% but they were sometimes reoccupied when these events were forgotten[4].

In many areas of Africa malaria is identified as "warm body" and the parents themselves give chloroquine tablets to febrile children. In fact 30% to 60% of fevers in children are really due to malaria in the Congo as well as in Burkina Faso[9,10]. Family treatment accounts probably for the low malaria mortality recently observed in these countries[11]. In most of the ethnic groups the role of mosquitoes in malaria transmission is well-known and the term Anopheline is sometimes mentioned, but villagers not being entomologists are unable to differentiate *Anopheles* from *Culex, Aedes* or *Mansonia*. Consequently, they consider the persistence of these mosquitoes as a failure of house spraying treatment for malaria control even when anophelines are efficiently controlled.

In mountainous areas of Cameroon, which are free of malaria, it was forbidden to spend the night in adjacent low valleys which were highly malarious.

The rapid evolution of the concepts about diseases and their transmission is very encouraging for health educators who have to take into account the cultural background of the population to explain the objectives of vector control.

Vector and Pest control

Very often the first results observed by the population determine whether or not they will give their further commitment towards vector control. The reduction of the nuisance due to insects, in other words the number of insect bites, provides the most effective initial incentive. Although it is not the main objective of vector control, the population usually expects it. The success of any campaign is judged more by the disappearance of mosquitoes, tsetse, blackflies or bedbugs rather than by its impact on malaria, filariasis or trypanosomiasis. The popular success of the Onchocerciasis Control Programme in West Africa has mainly been due to the disappearance of *Simulium damnosum s.l.*, allowing people to calmly cultivate the river valleys. Elimination of painful bites of tsetse flies is also making traps very popular among the villagers in the Congo[8] and in Ivory Coast.

Adversely, antimalaria spraying has been rejected in Madagascar and in Sao Tome because DDT resistant flies and bedbugs apparently began to multiply following house spraying according to the population. In the last country it was necessary to add malathion on the spraying.

To maintain the confidence of the community the selected vector control methods should be effective not only against the disease but also, as much as possible, against the pest insects.

Social and economic acceptance

Before introducing vector control measures at community level we should consider whether the technology selected is in harmony with local customs and attitudes to which people are deeply attached and the violation of which is taboo. These obstacles can generally be overcome with a sensitive approach towards the community e.g., tsetse trapping in sacred woods in Mali (Challier, personal communication).

The tasks to be undertaken should be consistent with the style of life of the people. A clear distinction should be drawn between the various tasks entrusted to community agents responsible for vector control (whether operating as volunteers or on a salaried basis) and those attributed to the whole population or to large groups of people. Villagers obviously cannot be expected to devote a large part of their time to vector control when they have to attend to agricultural activities. The form of participation expected from them should be consistent with their many tasks so as to ensure its continuation.

Environmental management is highly dependent on two major factors, namely the population density and the percentage of land under cultivation. In Africa, south of the Sahara, the mean population density is lower than 30 per km^2 and less than 15% of the land is actually cultivated. The villages, often of small size, are far from each other and each community owns large pieces of land. Under such conditions it is very difficult for them to properly manage the environment because of the limited manpower available. Of course, there are exceptions and some areas with high population density are found in Kenya, Nigeria, Cameroon, Rwanda etc.

PAST, PRESENT AND FUTURE OF CONTROL ACTIVITIES IN AFRICA

Impact of vector-borne diseases in Africa

Vector-borne diseases are among the most severe health problems in the African Region and this Region is probably the most affected by these diseases in the world. They cause a high mortality rate in the affected population and high morbidity, mainly in rural areas, which is a serious impediment to socioeconomic development.

Malaria is endemic in 90% of the Region, in most of the places at hyper or holoendemic level. Three hundred million people are affected by the parasite, and only survive because of immunity developed after initial bouts with the pathogenic agent. The disease accounts for 10 to 70% of the dispensaries' consultations depending on seasons and areas. The resistance to chloroquine of the main parasite *Plasmodium falciparum* is rapidly expanding from the east to the west of the continent.

More than twenty million people are at risk from onchocerciasis and probably more than ten million are infected. The more severe foci are in the savanna belt north of the equator. The blindness rate could reach 10% in affected communities. The disease, a major impediment to the development of agriculture in river valleys, has now been eliminated by the Onchocerciasis Control Programme from large areas of West Africa[4].

Foci of lymphatic filariasis are widespread in the Region leading to serious health problems on the East African coast, in Madagascar and in the Comoros Islands.

Dracunculiasis is found in most of the countries of the Region in discontinuous foci and is considered an important problem by many states.

African human trypanosomiasis, affecting probably less than 2,00,000 people, is nevertheless a serious threat since its resurgence can lead to severe epidemics like the one occurring now in Uganda.

Kala-azar has been mainly reported from Kenya and Sudan with scattered cases in Algeria and Ethiopia. Cutaneous leishmaniasis cases are found in the driest parts of the continent on the Sahara borders and in some mountainous areas.

Circulation of yellow fever virus between monkeys and sylvatic *Aedes* has been reported in many countries of West and Central Africa. Several outbreaks with different epidemiological patterns have been reported in the last 20 years in West Africa, the last being in 1983 in Ghana and Burkina Faso.

Sylvatic dengue fever has been identified in the same mosquitoes and monkeys as yellow fever and in the same foci. Urban epidemics occurred in the East Coast and in West Africa (Burkina Faso, 1982)[13,14].

Louse-borne typhus has mostly disappeared but has again become a problem in refugee camps.

Plague persists in its natural foci in the Central African Plateau and in Madagascar.

Possibly 50 million people of the Region are infected by schistosomiasis (*S. haematobium, S. mansoni, S. intercalatum*). Building dams and irrigation schemes everywhere is a major factor in increasing its spread.

This short review highlights the paramount vector-borne diseases in Africa. One can say that some diseases like malaria or schistosomiasis are so extensive that they can be considered as part of the human environment.

CONTROL METHODS THAT MAY BE IMPLEMENTED WITH COMMUNITY PARTICIPATION

Tsetse fly control

Clearing the forests and galleries which were considered as the base of non-chemical control of tsetse flies is now banned as forest protection has become a

major ecological problem. Destruction of game is also unacceptable. Massive spraying of insecticides, apart from its side effect on non-target fauna, is extremely costly and has to be repeated when flies reinvade cleared areas.

Traps aimed for tsetse sampling have proven to be very effective for control mainly when they are insecticide treated. Outstanding results have been obtained against riverine species of tsetse flies (*Glossina palpalis* group) in Ivory Coast[15] and in the Congo[16]. A trial of non impregnated traps in the Congo was successful[17]. Introduction of trapping into tsetse fly control makes it possible to envisage the transfer of this type of activity to the communities. Trials are in progress in Congo, traps are provided by health services but their maintenance is done by villagers, who check the catches and eventually move the traps to better catching sites, so far the experiment is very satisfactory and is used for training rural volunteers[8]. The trapping could be integrated in inter-sectoral activities in stock breeding areas to protect both human and animal health. It is a good tool to protect ranches which are being developed in many tsetse infested areas where at present only trypanotolerant strains of cattle can be bred.

Malaria vector control

In view of the importance of malaria in Africa, destruction of its vectors is a primary objective. At present there is no general method of achieving this aim in Africa, while the integrated approach appears difficult to put into effect. This is borne out by the report of the *ad hoc* consultation of the Scientific Working Group on Applied Field Research in Malaria held in Nairobi in October 1983[18]. Not only does it show the inadequacy of available control systems, it also reveals a disquieting lack of new proposals, and one may reasonably ask which particular elements may be integrated to some purpose and, consequently, what action is possible at community level.

House-spraying of dieldrin and DDT gave excellent results in the forest areas of Cameroon[19] and Liberia, yet failed to interrupt the transmission of malaria in the savanna regions of West Africa, such were the results of the various pilot projects carried out before 1963[20]. Since that time, the spread of resistance to dieldrin and development of resistance to DDT among species of the *A. gambiae* complex invalidate the use of organochlorine insecticides in many African countries. Alternative organophosphorus compounds are far more costly and have only been used on occasions or in pilot projects, some of them e.g., fenitrothion, gave excellent results. House-sparying is the only *Anopheles* control method that has been properly evaluated in Africa.

Anopheles larval control is especially difficult in Africa. As the population density is low and the breeding sites of both *A. gambiae s.l.* and *A. funestus* very extensive, the ratio of the breeding sites versus man is very high. Moreover, *A. gambiae s.l.* larval sites are scattered and of very temporary nature in rainy season. A. *funestus* breeding sites occupy vast expanses of territory and are covered by dense aquatic vegetation which makes any

control agent difficult to employ. Larval controi measures, whether in the form of insecticides, biological agents or environmental sanitation, can only be implemented at the present time in a limited number of cases where breeding sites are easy to identify and not too extensive. Such measures cannot be applied generally, but rather on a local basis.

Mention should be made of the case of Somalia where *A. arabiensis* sites, consisting of man-made water reservoirs, were brought under control using larvivorous fish *Oreochromis spilurus*, resulting in a substantial decrease of malaria indices[21]. It may be possible to use the same technique in the Grande Comore where there is no ground water. Research on larvivorous fish use has been undertaken in Sudan.

In forest areas, *A. gambiae* breeding sites are often fewer in number, less extensive and found in clearings, some of them could well be treated or destroyed. In 1957, one of the authors observed that road repairs, thereby filling the ruts, led to the disappearance of *Anopheles* and, as a result, of malaria transmission in the village served by the road.

Such examples are exceptional in the context of Africa, south of the Sahara. The possibility and effectiveness of treating larval breeding sites should be reviewed very carefully on local basis.

Replacing chemical larvicides such as temephos, which is not very harmful to the environment, by bacterial preparations such as *Bacillus thuringiensis* H 14 is not a very significant step forward, formulations of the latter are not residual, because the active ingredient does not remain in suspension and treatment has to be repeated every week, thereby costing far more than house-spraying[22,23]. Fish cannot be used in scattered temporary water-beds even with restocking, there has been talk for more than 20 years of introducing *Notobranchius* whose eggs are resistant to drying, but no progress has been made in this direction. Reducing breeding sites is such an undertaking considering their size and the available manpower that it would be quite unrealistic to attempt it in most rural areas. In towns where it might well be envisaged it would require action on the part of the municipal authorities and serious technical and sociological approaches.

Wherever it is envisaged, feasibility of *Anopheles* larval control and its real impact on clinical manifestations of malaria should be carefully evaluated under African conditions. Wihout proper evaluation, there is a danger of making, the people pay a heavy price for poor results.

In some countries like Ethiopia, Guinea and Mozambique, community participation in house spraying operations has already been experienced. In Ethiopia organized community participation involving local farmers' associations began in 1979 and has resulted in an increase in the number of houses sprayed as well as a general increase in efficiency[2].

However, in Africa, the main thrust of community participation to malaria control has been on therapy, in compliance with the WHO Regional Committee Policy.

Control of other vector mosquitoes

Aedes aegypti would be an ideal target for nonchemical control particularly in urban areas. Cleaning or eliminating the containers acting as larval breeding sites can be done by the communities where good health education activity can be carried out.

The threat of yellow-fever epidemics before the vaccine was available led to a very severe legislation regarding the suppression of any potential breeding place including tree holes and certain plants. These measures were said to have been very effective during the first half of the century. When yellow fever vaccine appeared, thereby providing total protection these measures were no longer easily accepted. In the last 20 years urban yellow fever outbreaks have appeared in unvaccinated people, involving *Aedes aegypti*. Moreover, dengue epidemics spread in East Africa as well as in West Africa[6] emphasizing the importance of *Aedes aegypti* control.

In towns and even villages the number of receptacles as potential breeding places of *Aedes aegypti* is continuously increasing with the popularisation of plastic packing. In towns, the municipality should remove or burn used containers if breeding sites are not simply to be transferred from houses to rubbish dumps a few yards away. Keeping drinking water in houses is a traditional practice[24] of certain ethnic groups which can persist even when tap water becomes available. Serious health education efforts are needed to change such behaviour. If treatment with insecticides (temephos) or microbial preparations (*B. thuringiensis*) is needed, it could be done by community agents.

Control of sylvatic *Aedes* (*A. simpsoni, A. africanus, A. luteocephalus, A. furcifer/taylori* and feral forms of *A. aegypti*) is practically impossible unless their breeding places are in a peridomestic situation where they can be eliminated (filling tree holes, removing some plants like *Colocasia, Musa ensert* etc.) or treated. Any measure can only be planned according to the local ecology of these mosquitoes.

Culex quinquefasciatus is a growing problem linked to urbanization. As it is one of the few species resistant to household detergents it has no competitors and few predators in the polluted urban waters[25]. Apart from its role in the transmission of filariasis it is a serious nuisance pest in towns. This mosquito is spreading out to rural areas as more and more detergent is used by householders. The insecticide treatments by chlopyrifos or fenthion are restricted by the development of resistance. *Bacillus sphaericus* holds out promise and so do insect growth inhibitors of the juvenile groups[26]. Such

treatments are mostly applied by municipal health employees but could be transferred to community agents if properly trained. The reduction of breeding sources through urban sanitary measures, including proper drainage and cleaning of drains and sewage systems, needs major civil engineering operations on the part of municipal authorities. Community agents can participate in the maintenance and functioning of the sanitary network.

Periodically there are proposals for better latrines or cesspits but no one, up to now, has been able to reduce mosquito production and an effort in this area is desirable.

Locally imaginative solutions have been introduced by the people. For example, in some coastal areas of East Africa they introduce salt in the latrines to curb the development of *Culex quinquefasciatus*.

Black fly control

As mentioned before the onchocerciasis control in Africa is mainly carried out by the Onchocerciasis Control Programme in the Region of the Volta River Basin (OCP). It is based on weekly aerial treatments of every productive breeding place with temephos, chlorphoxim, Teknar ® or, recently, permethrin.

From the very beginning OCP was interested in community participation in its huge vertical programme structure and was aware of the difficulty of involving people in the control operation. An information campaign was undertaken to make people aware of the effects of the diseases, their transmission patterns and the aims of the programme. It was a success and now in most of the villages of the exposed areas people are strong supporters of OCP. Moreover, governments and people outside the treated areas are asking to be included.

Except in rare situations, such treatment is not within the capabilities of the communities or of health peripheral units. But when participation appeared possible, it has been fully exploited. In the Selingue dam watergates are used alternatively to dry the breeding place on the spillways. In the Bandiagara Plateau, at the extreme north of its distribution area the disease is only seasonal and most of the breeding sites result from small dams, recently built for irrigation. Community agents under the supervision of Programme technicians participate in the surveillance system, reporting the appearance of flies. They also contribute to the mechanical elimination of the breedings sites on the spillways and they are trained for limited chemical ground treatment. This approach has been very successful[12,4]. But the Bandiagara area is an exception and such simple control methods cannot be applied to more than 5% of the whole river system of the OCP area.

If drugs usable for mass administration would become available community participation should be reconsidered.

It has been recommended to build villages far from infested rivers. Of course it is a good preventive measure but the goal of onchocerciasis control is precisely to reoccupy the infested valleys. It has been proved in the OCP area that when the population density reaches 50 per km^2 the gravity of the disease decreases considerably even in the most infested places[27]. Dense occupation of land can to a certain extent be considered a prophylactic measure.

Control of Guinea-worm

Although it is possible to control the *Cyclops* with insecticides e.g., temephos, DDT, in the breeding places or in drinking water, the main approach for Guinea-worm control is by improvement of water sources. Spectacular results have been obtained in India. In Africa good results have been achieved in Ivory Coast in building suitable wells[28]. As part of the Water Decade, a great effort is being made in many African countries to improve the supply of potable water which will probably decrease the prevalence of the disease. A campaign of health education has been undertaken in several countries of West Africa by OCCGE, (Office de Cooperation et de Coordination pour la lutte contre les Grandes Endemies, Bobo-Dioulasso, Burkina Faso) which produced a leaflet to inform and guide the population[29]. In particular it is recommended that the worm carriers do not put their legs in drinking water sources when they are swollen and the villagers are advised to filter water when no safe source of drinking water is available.

In some places in the Sahel area where wells are functioning, people continue to drink water from the infested pools, which they consider tastier Such behaviour can only be changed by health education.

Snail control

There is a lot of literature on the link between population behaviour and schistosomiasis contamination, health education remains one of the bases of disease prevention. But the recommendations are rarely followed because they are too restrictive. They need to be locally adapted to the way of life of the populations who generally are not frightened by schistosomiasis. Presence of blood in urine is even considered as a normal event of the life of young people in many areas.

In Niger, in an irrigated rice-field area near Niamey the community is now taking charge of cleaning the water channels which are the main, if not the only source of *Bulinus* snails. This action is undertaken through a national development agency in charge of irrigation and water management. In Mali there is an attempt to involve the community agents in using molluscicides in the treatment of the schistosomiasis foci.

The use of local molluscicidal plants like *Phytolacca dodecandra* has been encouraged but more information about their chronic toxicity and mutagenicity is desirable. Upto now there is no report on their utilisation by the communities.

At the present time schistosomiasis control in Africa is mainly based on chemotherapy. Complementary snail control should be strongly coordinated with the medical approach. The full set of activities should be planned locally. The use of snails predators and antagonists is still at an experimental stage[30].

Integrated control and Inter-sectoral activities

Integrated control is another magical approach thought to solve all the difficulties encountered by vector control. In fact it is a philosophy and not a method and its efficacy will depend on the methods and tools which could be integrated. They have been reviewed by a WHO Expert Committee in 1983[1]. Their ability to be utilized at community level in Africa was discussed in a WHO consultation in Brazzaville in 1985[12].

Integrated control should be planned locally according to the epidemiological situation, vector ecology and socioeconomic situation taking into account all the possible methods of control which have already been envisaged in this paper. Again we stress the need of a highly qualified team of specialists to select appropriate technologies and methods.

In Africa no organized effort has yet been undertaken to build up experimental projects taking into account specific African conditions already described. This is a pre-requisite to the development of integrated control in the region.

Although man is little inclined to alter his environment for the good of his health, he is nonetheless transforming it radically in order to carry out development projects. Dams are being built whose reservoirs cover wide areas, whole tracts of land are being irrigated, partly for the cultivation of rice, while land is often cleared at the expense of wooded areas that are shrinking away and are rarely replaced through reforestation. These ecological alterations lead to significant changes in vector distribution. Whereas the populations of tsetse flies have shrunk with the disappearance of gallery forests in the Sahel region, breeding sites of intermediate hosts of schistosomiasis and of *Anopheles* larvae abound in dammed reservoirs and irrigated land. Black flies tend to breed in the spillways of dams and can cause serious local outbreaks of onchocerciasis in areas where the disease did not exist before, as on the Dogon Plateau in Mali. Urban development leads to proliferation of *Culex quinquefasciatus* and *Aedes aegypti*.

It is at the planning stage of construction that decisions should be made regarding the necessary steps to minimize establishment and multiplication of vectors. For instance, operating sluice gates on an alternating basis can prevent the development of *Simulium damnosum* breeding sites[7].

In the new situations arising from the modification of environment by agricultural practices it is necessary to be cautious in the choice of vector control to be implemented. In this respect, the approach in paddy-fields is quite revealing. Generally speaking, the development of flooded rice fields

leads to a significant increase in the number of anophelines in nearby villages when the plots are actually being flooded[31]. Research carried out in Burkina Faso[32] has shown that the "Mopti" cytotype of *Anopheles gambiae* prevailing in the paddy-fields was not as good a vector as the "savanna" cytotype of the same species prevailing in villages outside the rice cultivated area. Paradoxically the malaria transmission is lower in the villages of the rice area than in the other villages even when people received five times more *Anopheles* bites. Nevertheless malaria was hyperendemic in the two situations but in the rice field area people had a better access to curative drugs. The priority given to vector control in rice fields in such a situation will depend on the general health policy of the country.

Individual protective measures

Mosquito-nets are excellent means of individual protection, they would cost far less if manufactured locally from available materials, thus leading to their wider use. Impregnating the net with pyrethroid insecticide reduces man-mosquito contact even when mosquito netting has holes. Impregnated mosquito nets of this type have been successfully tested at present in several research centres in Burkina Faso[33], Mali and Tanzania[34]. Nets under which people sleep strongly attract anthropophilic mosquitoes. Their treatment can be considered as a highly selective house spraying. This has to be evaluated epidemiologically. In Burkina Faso, the Health Services intend to make widespread use of nets, both for malaria prevention and to improve population welfare.

Mosquito-proof wire mesh can only be fitted to doors and windows of certain types of building and as a rule is not suited to the dwellings of the poorest rural communities.

Insecticide coils are now used widely in Africa. They provide excellent protection against all types of mosquitoes and particularly against *Culex quinquefasciatus* and *Mansonia*. This will considerably reduce the rate of mosquito bites and thereby contribute significantly to *Wuchereria bancrofti* control.

The action of commercial repellents is generally short-lived. Many types of local products are regarded as being repellent, their effectiveness and harmlessness have to be evaluated.

RESEARCH NEEDS

The relatively short list of vector control methods that can be used in tropical Africa, coupled with the problem of defining the particular potentialities of each one, highlights the very pressing need for appropriate research to implement the new policy of integrated vector control. The research needs may be listed under four headings.

a. *General epidemiological research* in order to stratify the various diseases in each region and identify the vectors responsible for transmission, this requires research on vector ecology and behaviour in relation to human habits and housing.

b. *Research on control methods* development of traps for control and sampling, research on use of pesticides, bacterial preparations and biological control agents (larvivorous fish, snail antagonist, predator, etc.), research on local insecticides or repellents both for *in situ* use and to identify new molecular leads, evaluation of the potential of individual protective measures.

c. *Evaluation* of each of the measures planned and of the association of several of them such evaluation should extend to the epidemiological level and also their social and economic feasibility. The benefits and constraints of vector control activities may be assessed in comparison with the use of drugs, possibly leading to a combination of the two approaches.

d. *Anthropological, social and economic research* on the conditions which facilitate or constrain the participation of rural and urban communities in control activities.

TRAINING

As we have already said, the implementation of an integrated and decentralized vector control policy calls for the acquisition of a sound scientific background, including the training of senior specialists in medical entomology and epidemiology as well as in social sciences. WHO has made a special effort in these two fields in Africa since three courses of medical entomology (at third- cycle level in French-speaking countries and Master's degree level in English-speaking countries) have been started at the Universities of Abidjan (Bouake Centre), Jos and Nairobi. Various courses in epidemiology have also been started. It would be of some value if these training courses were specifically to include activities at community level involving an approach in which theory is inseparable from practice and technology, to take full account of cultural and social realities. Collaboration between developing countries in the field of medical entomology training, in itself carries a meaningful message. Appropriate training should be developed for social scientists working in health activities.

Middle-level workers should be trained in the country itself, as should peripheral health workers. They should receive general instruction in other fields as well as learning the techniques they shall be called upon to use. This is an effective way of motivating them and earning credit for them in the eyes of the community.

CONCLUSION

Placing vector control in the hands of the community means converting its members, who up to now have been spectators, into active participants. Communities should be motivated to participate on a lasting basis through the use of positive actions that are also seen to be effective. In view of the rudimentary technical level of peripheral health workers, this means choosing the simplest methods. Simplicity and effectiveness can only be achieved through first-rate knowledge of disease epidemiology, vector bioecology and human ecology, thereby necessitating a top-level interdisciplinary team. Community activity can only succeed through the meticulous preparation and selection of appropriate techniques and methods followed by permanent technical, scientific and material support. What is called for, therefore, is the organisation of staff training at several levels, senior workers charged with analysing situations and promoting appropriate new control methods, middle-level workers charged with organizing, monitoring and evaluating operations, and basic workers charged with putting the selected methods into effect.

Ever since the development of primary health care has come to be regarded as the means of promoting health for all, a spate of articles, often the work of theorists rather than practitioners, has highlighted the need to develop simple vector control methods based on community involvement and calling for the greatest possible use of environmental management. No doubt, the aim of their authors is praiseworthy, yet their efforts may lead to confusion. The fact is that their writings give the impression that such methods are available for immediate use, whereas in fact they are actually at an experimental stage.

It is even more important that actions to be undertaken must be geared to the specific conditions. Global strategies need to show a greater sensitivity to local situations.

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1065
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Approaches for Community Participation in *Aedes aegypti* control, Phanus Nikhom District, Chonburi Province

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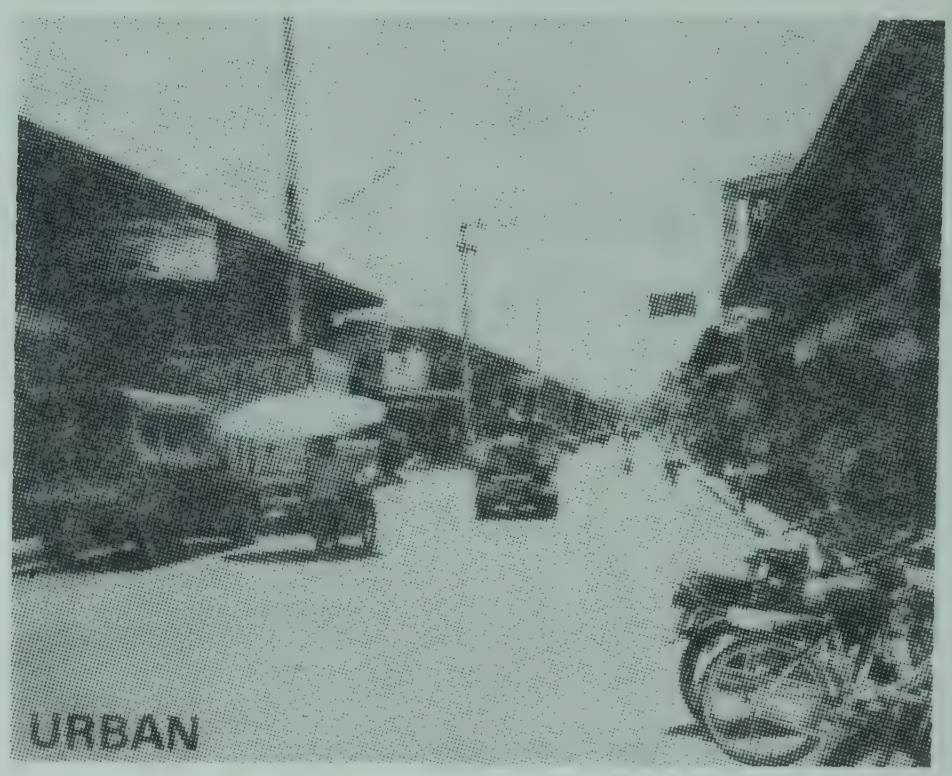
From the entomological point of view Dengue Haemorrhagic Fever in Thailand is hard to control due to high prevalence of *Aedes aegypti* in both urban and rural areas throughout the country. Larviciding with 96–98% coverage is a promising control measure but it requires laborious supervision and large manpower. Since man has contributed to the breeding of the *Aedes aegypti* mosquito, the most economical way is to develop mechanisms for the people to delegate their responsibilities, authority and resources in the prevention and control of the disease through source reduction. The objective of this study was to find the most effective method for motivating people to realize the problem and to participate in solving the problem.

This study has been conducted in a district in Chonburi province for three years (1982–1985), however, it is not yet time to reach any conclusion. The activities carried out could be summarized into three approaches which are: approach to local authorities, approach to the public and school approach.

THE STUDY AREA

Studies were carried out simultaneously in three subdistricts of District Phanus Nikhom, Chonburi province i.e., Phanus Nikhom municipality (urban) and two neighbouring subdistricts, Wat Boat and Wat Luang (Fig. 1).

1. Bangkok
2. Chonburi



(A) (B)

Fig. 1: (A) Map of Thailand showing the study province and Bangkok. (B) Views of urban and rural areas in Phanus Nikhom.

In the municipality there were 2,221 premises on a surface area of 2.8 km^2, most of them were provided with piped water supplies. Shop-houses predominated in the centre of town, whereas on its outskirts, separate large compounds were common. Unlike the urban municipality, housing in the two rural subdistricts was spaced out in villages and surrounded by paddy fields. Domestic water needs are mostly dependent on stored rain water and partially upon canal water or wells. For this reason the average number of domestic water containers (15.9/premise) was nearly twice as many as in the urban area (Table 1).

Wat Boat is comprised of 10 villages each with 45 to 91 houses with a total of 675 premises, whereas Wat Luang had seven villages and a total of 549

Table 1. Basic statistics of three study areas in Phanus Nikhom District, Chonburi Province, Thailand, 1983

Items	Study areas		
	Municipality (urban)	Wat Boat (rural)	Wat Luang (rural)
Area (km^2)	2.8	18.9	11.8
Number of villages	—	10	7
Number of premises	2,221	675	549
Total population	13,478	3,625	3,115
Population per km^2	4,814	193	264
Number of schools			
Elementary	6	1	1
Secondary	2	1	0
Health volunteers			
Number of primary health care volunteers	2	10	7
Number of communicators	2	41	70
Number of containers per premises			
Water jars	8.2	15.9	—
Ant traps	1.2	2.3	—
Others	0.8	2.3	—

premises. Each village was headed by an elected village chief. There was also a multipurpose primary health care volunteer (PHC/V) in each village, whose work was supported by a health communicator for every ten premises. Numerous health delivery activities of these volunteers were coordinated by health officers at the sub-district health centre.

The whole district was governed by the authorized sheriff with government officials and an elected Lord Mayor assisted by municipality members.

APPROACH TO LOCAL AUTHORITIES

In order to provide provincial health officers with general information on the biology and control of *Ae. aegypti* through source reduction within the community, a three day public health training course was held for 33 health officers who were responsible for disease vector control in four different provinces adjacent to the province of Chonburi.

A coordinating committee was organized, chaired by the Sheriff. The committee appointed by the governor comprised of Lord Mayor, chief of the municipal education office, director of the municipal hospital, chief of office of the municipal health officers, representatives from non-government organizations: local news agency, Lions club, cultural and religious associations and school principals. Meetings were held occasionally to discuss the progress of the project, to provide recommendations from the committee members and to obtain their participation in vector control.

APPROACH TO THE PUBLIC

Objectives

The target of this approach was to organize a vector campaign by recruiting volunteers to participate in the activity. To prepare for such activity a district-wide workshop was carried out for 97 participants, they were local village chiefs, village scouts and some school teachers. Besides the larval habitats they were informed of possible roles in larvicidal campaign especially to assist the family individual in identifying mosquito breeding receptacles, removal of non-essential water containers, and larviciding with temephos and methoprene (IGR) if possible.

Public education through mass media

Prior to each vector campaign the public was educated by fortnightly radio lectures about DHF, number of reported cases, the prevalence of the mosquito vectors, the breeding habitats and simple control measures. Announcements were made along the streets about the schedule of the campaign. To draw public attention, official opening ceremony of the campaign, poster demonstrations, street parades and children's masked marches were carried out. These activities were carried out very well together by the local officers and school children.

Larval campaigns

Larval campaigns were carried out differently in the first and the second year of the study. In the first year the recruited volunteers visited houses and carried out larval control via temephos applications and removal of non-essential receptacles. This method did not require the participation of the people but the effort and cooperation of the volunteers was involved.

Therefore, in the second year of the study the method was changed. Instead of applying temephos, volunteer school children are assigned to visit the houses, to inspect receptacles for breeding and then record on the inspection form the number of containers with larval infestation. After inspection they hand over the form to the house owners. The house owners bring the forms to receive temephos and methoprene from the officers located nearby. The people should use the larvicide received for controlling the *Aedes* larvae in the containers as recommended by the school children or mechanically remove non-essential containers.

Public interviews

Before carrying out *Aedes* campaign in the second year, a staff team was assigned to carry out public interviews. Five hundred families were visited and interviewed. The information obtained was that 90 per cent of the people had known about the *Aedes aegypti* habitats through house visits of the

volunteers. When asked whether they would control the larvae by themselves or not, they said that they would do it if they were provided with temephos or methoprene.

SCHOOL APPROACH

In the second year of the project all the schools were approached because students were found more cooperative than older people. The people participated transiently in vector campaign which resulted in a short term control. To implement a long term control it is important to generate awareness about mosquito larvae among the younger generation, therefore, the following activities were carried out.

A workshop for school teachers was organized in the municipality in which 83 school teachers participated. The programme was similar to the workshop for volunteers in the first year. The teachers seemed to be quite interested in the subject and willing to share their opinions in transferring the knowledge to the school children.

Pre-campaign training was given to school children, in the first year. Before the second and third campaign, school children were recruited and trained. There were altogether approximately 300 school children. In the second year two campaigns were carried out and two groups of children were trained again, the first group consisted of 360 children and the second group of 150 children. On the morning of the campaign day a briefing on their duties was given.

In the second year, 67 teachers who were responsible for health education in the schools were trained. The purpose was to instruct them to transfer this knowledge to their students correctly and to assign the children to larval survey in their own houses.

Teaching aids were provided to 11 schools. Entomologists were assigned to visit all the schools to assist the teachers.

Temephos 1% sand granules were given to the schools. School children were assigned to carry out larval surveys in their own houses. They were given temephos to control the positive containers as well.

School approach began in the middle of the second year of the study and continued into the third year.

EVALUATION

To evaluate the results of the project, the cooperation of the authorities, people and schools was taken into account. The target of the project was to bring down the mosquito density. Therefore, *Aedes aegypti* larval surveys have been carried out before and during the campaign at intervals.

RESULTS

Participation of local authorities

In the first year health officers were trained and the higher authorities gave full support for training. During the campaigns and workshops all local health officers had assisted in all the activities making the programme go smoothly. They were responsible for public information and the official opening ceremony.

In the second year, the coordinating committee was appointed and the members attended the meetings regularly. They showed their interest in the project and gave comments and suggestions. School approach was suggested by the committee. In the third year of the study the committee decided to carry out vector campaign. In the third year *Aedes* campaign was carried out in August. Volunteers were recruited (mostly health officers such as nursing students and primary health care volunteers) to participate in the campaign. However, temephos 1% sand granules were provided by the project.

Participation of the people

Participation in the first year (1983) was determined by the number of volunteers and rate of temephos acceptance. In the first year three mass campaigns were carried out. The first campaign was supported by a total of 227 volunteers, who gave larvicidal treatment during house-to-house visits, with technical assistance of the staff from the Department of Medical Sciences.

In the municipality area, each volunteer covered about 26 houses as compared to 10.6 houses per volunteer in rural area (Table 2). It was found that families in urban areas were less cooperative than in villages, where the selected volunteers were also found to be more enthusiastic, giving more frequent visits after the mass campaign week. In urban areas the number of houses covered and treated was 86% during the first campaign which reduced during the succeeding campaigns while in rural villages it was increased.

Table 2. Number of houses treated with 1% temephos SG by volunteers in two study areas, District Phanus Nikhom, Chonburi Province, Thailand (1983)

Area (km^2)	Applications	Number of volunteers†	Number of houses treated	1 per cent temephos SG used (kg)‡
Urban (2,221)	First	112	1,913	124
	Second	34 (80)	1,554	119
	Third	24 (100)	1,592	153 (44)
Rural (1,224)	First	115	988	75
Wat Boat	Second	100 (99)	988	125
Wat Luang	Third	35 (40)	1,059	103 (25)

† Number of students who participated are shown in parentheses.
‡ Amount of 10 per cent methoprene in kg is indicated in parentheses.

Unlike the first campaign in February the participation of the volunteers (especially in the municipal area) in the second campaign in April was rather poor as anticipated (Table 2). Therefore, school children (above fifth grade) who volunteered were trained and the campaign was repeated that month. As a result, volunteer school children were among the main functional group during the subsequent campaign.

In the second year of study (1984) the method of campaign was changed according to the feedback from public interviews. People were willing to carry out larval control if they were provided with larvicides. Therefore, instead of applying temephos for them, the house owners were provided with temephos on request. Public participation was determined by the number of requests for temephos and its use to control larvae in their own compounds. It was seen that during the first campaign (of the second year) 956 families out of 1,636 (58.4%) in urban areas requested for temephos and in the second campaign 657 families out of 1,493 (44%) requested for temephos. On following up the families who requested temephos it was found that only 40% of them were applying it to control the *Aedes* larvae (Table 3).

Table 3. Temephos application survey one week after first and second campaign in urban area, District Phanus Nikhom, Chonburi Province (1984)

Parameters	I campaign	II campaign
Number of houses visited	1,636	1,493
Number of families taking temephos	956	657
Amount of 1% temephos SG supplied (kg)	164.8	124.4
% of families used temephos	34.1	44.5
% complete application	1.9	2.6

Participation of schools and school children

A number of school children participated in the campaigns. They carried out larval surveys and larval control in their own houses (Table 4).

Table 4. Participation of school children in vector campaign*

Year	Campaign	Number of school children participated	No. of houses visited
	First	0	0
1983	Second	80	1,554**
	Third	100	1,592**
1984	First	329	1,636
	Second	196	1,493

*Urban area only.

**Including houses visited by adult volunteers.

Ten out of eleven schools carried out larval surveys, one school was an elementary school hence, they were too young to do this job. The number of school children who got survey cards was 2,492 out of these 1,240 sent back the completed cards. However, every child was provided with 100 gm of 1% temephos SG and a total 230 kgs of temephos was distributed. It was not followed up whether they used the temephos or not.

IMPACT ON DHF CASES

Though the Breteau Index had been reduced 60 to 80 per cent, the index was still as high as 115 to 165 (Table 5). Therefore, one could not expect

Table 5. Number of yearly DHF cases in three study areas of Phanus Nikhom District, Chonburi Province, Thailand

Locations	Year								
	1977	1978	1979	1980	1981	1982	1983	1984	1985
Study areas									
Municipality	14	17	15	65	2	8	33	14	12
Wat Boat	2	1	2	32	0	9	2	1	8
Wat Luang	0	7	1	31	0	16	4	0	26
Phanus Nikhom district	88	93	45	549	25	84	249	50	272
Chonburi province	1,086	275	311	1,759	108	406	1,408	414	1,887
Whole country*	38.8	12.5	11.5	43.6	25.6	22.3	30.0	68.3	72.3

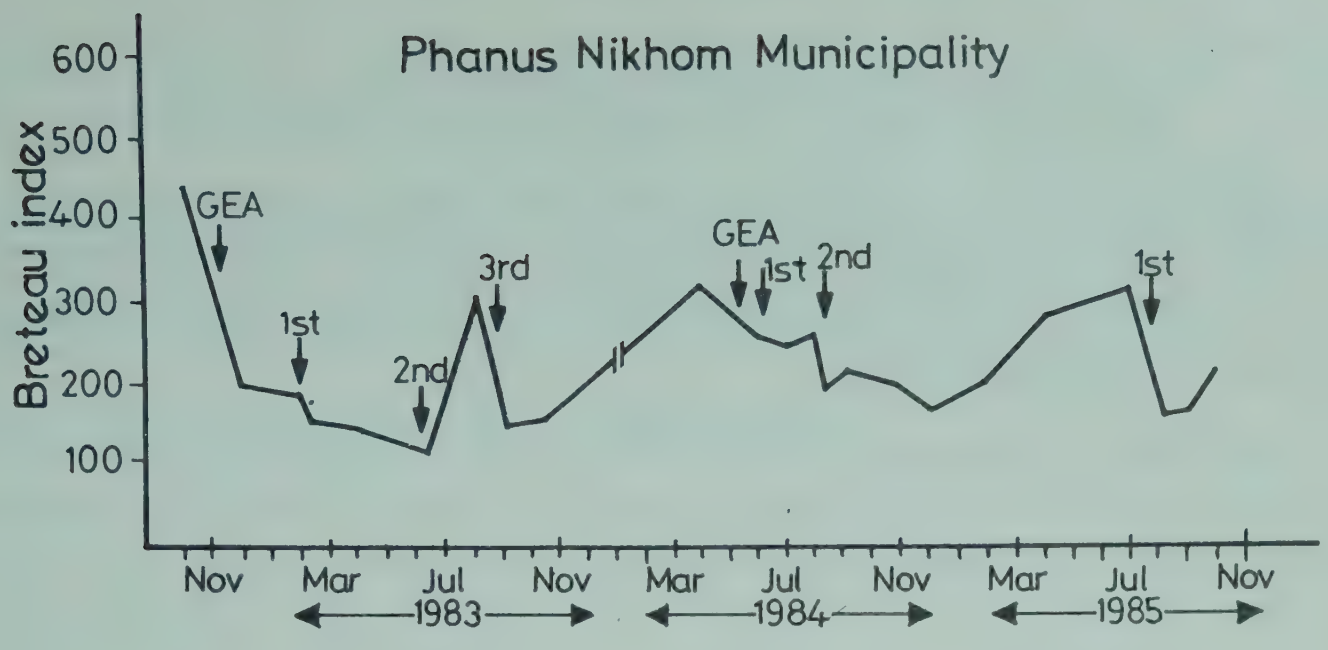
*In thousand.

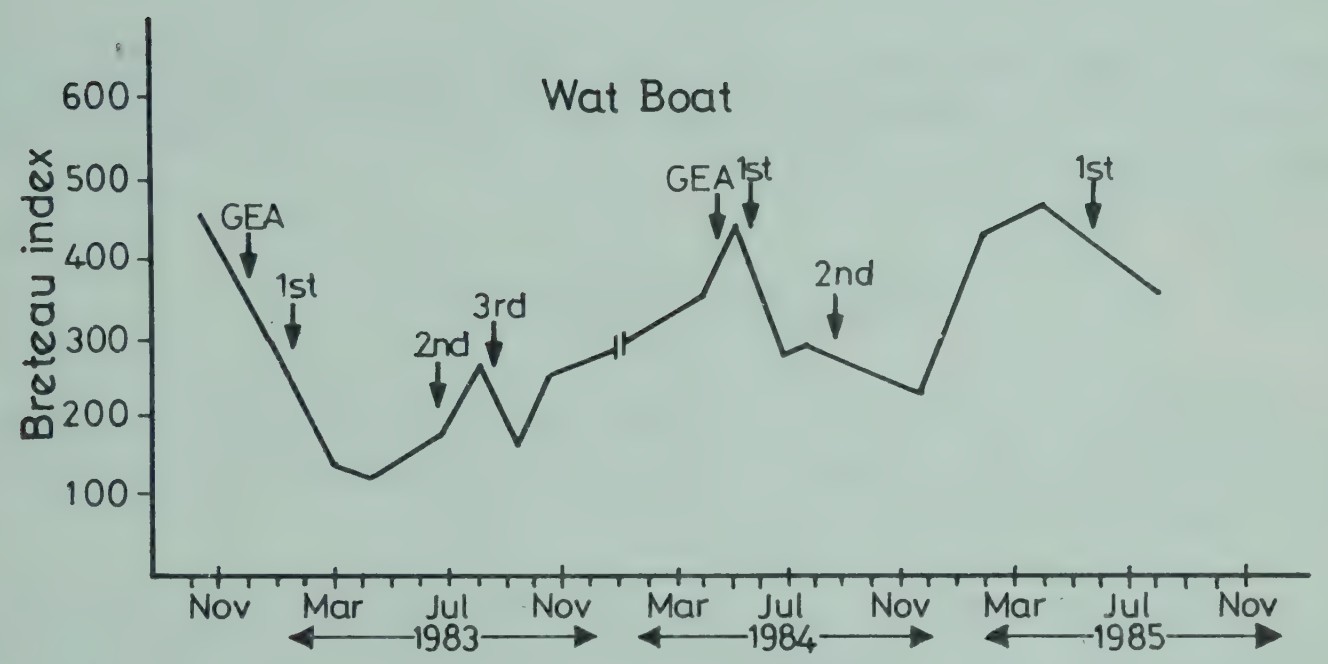
interruption of transmission. However, reported cases from the urban area was low for two consecutive years as compared to the high incidence in the whole country. The rural areas, Wat Boat and Wat Luang had high incidence in 1985. In 1985 the Primary Health Care volunteers and the chief of the subdistrict were changed and control activities were thus neglected.

DISCUSSION

This field trial had been carried out with the purpose of motivating the people to share responsibility in the prevention and control of Dengue Haemorrhagic fever. The local authorities were approached and they gave a good response by continuing the campaign activities. People were approached by giving information through mass media, house visits and they were provided temephos. The response from the people in terms of participation in vector control was low because, though, a number of people request the issue of temephos, very low percentage use it to carry out source reduction.

Since the people have become used to the mosquitoes they do not realize the hazards. Motivation carried out several times a year seems to make the people





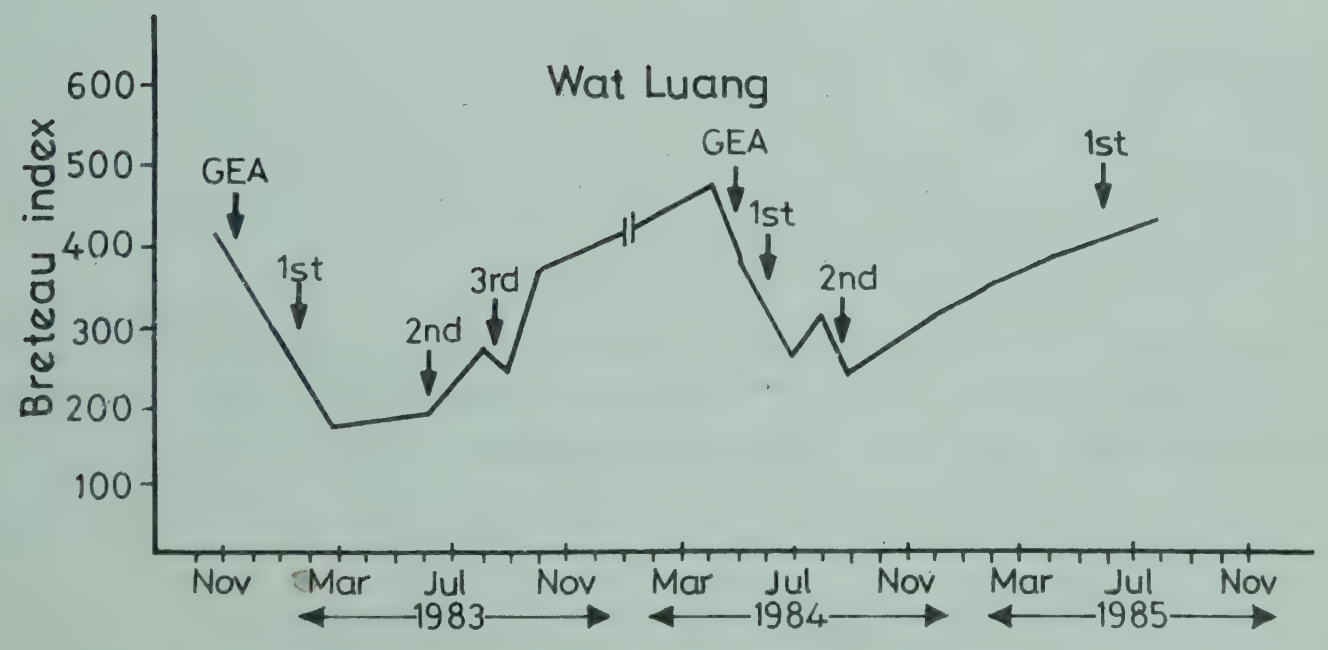


Fig. 2: Breteau index determined in three study areas after each control campaign, district Phanus Nikhom, Chonburi province, Thailand.
LEGEND: GEA = training or workshop.

bored of this activity. It may, therefore, be better to leave the motivation activity to the local authorities to be carried out perhaps once a year.

Aedes control by the people seemed to reduce the vector to a certain level. In this trial in both rural and urban areas the Breteau Index was reduced to 115–133 and not less than that level (Fig. 2). To obtain better results close supervision should be tried.

To implement a long term control strategy more efforts are required. This should be a matter of changing behavioural and cultural practices which could not be done by imparting information in a short period of time. The strategy of primary health care, that is to motivate people to realize their problems by themselves and guiding them to solve problems themselves should be practical and possible. In rural areas it may be easier than in urban areas as people are not too busy with social activities.

The school approach activity will also stop automatically if there is no following up or no stimulation and the trial will be useless. However. follow up will be done for couple of years.

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Village level Community Participation in Malaria control with emphasis on Environmental Manipulation in Nepal

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INTRODUCTION

Nepal is a landlocked country bordered by China and India (Fig. 1). This Himalayan kingdom with a surface area of 1,47,181 km² represents four distinct landscapes. Disease occurrence pattern, specially malaria endemicity is closely related to these landscape features; (1) the high Himalayan mountains to the north (alt. 4000–8800 m), (2) the Mahabharat range (alt. 1500–4900 m), (3) the Sivalik-Churia low mountains chain (alt. 200–500 m), and (4) the southern alluvial plains, the Terai (alt. 200–300 m) spreading to the Indian border. Owing to these physiographical features there is a wide range of climatic variations. The climate ranges from Alpine in the highlands, temperate in the midlands and Mahabharat range and sub-tropical in the foothills and the Terai regions. The monsoon brings heavy precipitation from June to September. The total population of Nepal is 16 million of which 91% are engaged in farming. Main crops are paddy, maize, pulses, barley, wheat and potatoes. The important cash crops are jute, sugarcane, tobacco and oilseeds.

The regions sloping down from the Mahabharat ranges and the deep valleys between these chains are potentially malarious. The transmission of malaria is more or less perennial in the Terai and the forested foothills while, in the higher valleys of Mahabharat range it is seasonal, mostly of short duration. An epidemiological stratification based on the topographical landscapes and

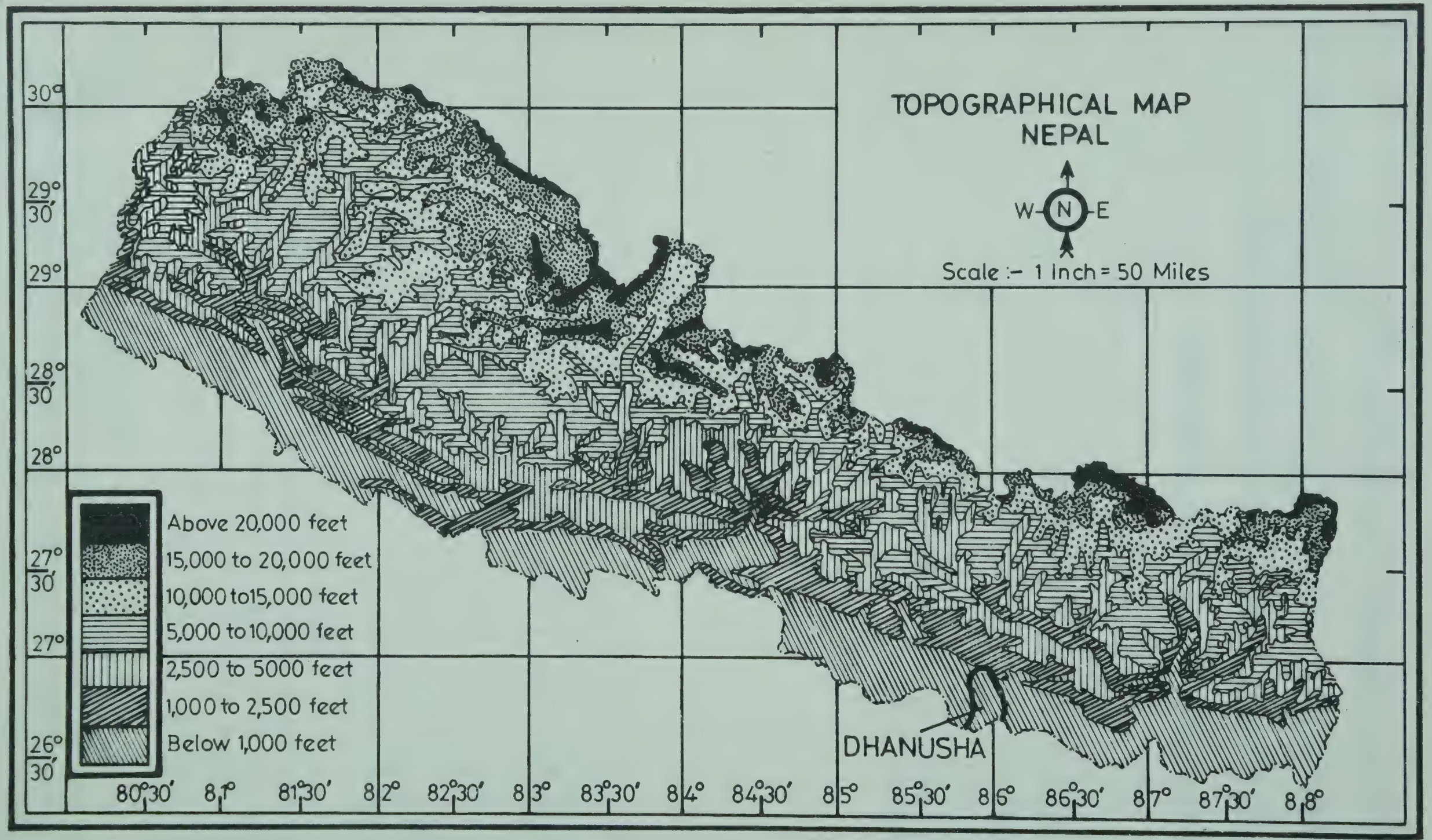

Fig. 1: Topographical map of Nepal showing district Dhanusha.

receptivity, divided the malarious areas into a low receptive area (outer Terai and also high valleys up to 1300 m MSL) and moderate receptive area (the inner Terai and forested foothills). In the low receptive Terai area *A. annularis* has been incriminated as vector and *A. fluviatilis*/*A. maculatus* are the malaria vectors in the valleys while *A. fluviatilis*/*A. maculatus* are the vectors in the moderate receptive areas. *A. maculatus* has recently been implicated and *A. annularis* is resistant to DDT. All vectors are susceptible to malathion.

The history of malaria control programme dates back to the fifties. The vector-borne diseases control programme started in limited areas in 1952 and in 1954, Nepal Malaria Eradication Organization (NMEO) was established. In 1970, a country-wide Malaria Eradication Programme (MEP) covered all malarious areas in Nepal. The achievements were brilliant with only about 2500 cases in 1971 and 1972. Total cases prior to the launching of the programme were said to be around two million every year. Due to a number of constraints the programme faced setbacks after 1971/72 and the Malaria Eradication Programme was able to maintain case level at 15–16 thousand every year. During early eighties the further increase of cases was noted. In 1983 there were about 17,000 recorded cases and in 1984, the total number of cases detected was around 29,000. *P. vivax* is the dominant species (80–90%) while *P. falciparum* is 10–20%. The percentage of imported 'A' cases was 30–35%.

The present malaria control strategy is surveillance operations and selective insecticidal spraying (DDT, Malathion and Ficam).

The Terai belt which extends from east to west is the northern expansion of the Indo-Gangetic Plain. Its width in Nepal is 26–32 km and altitude is 200–300 m. It occupies 40% of total land area of Nepal and 60–65% of the country's population resides in the Terai. The climate is sub-tropical, during the monsoon (June-September) the average precipitation reaches 3000 mm. Fertility of soil gives the Terai a high agricultural potential which, due to short span of rainy season has to be promoted by irrigation. Numerous irrigation and agricultural development projects are operating in these areas with the result that the local ecology is in a state of rapid transformation creating favourable conditions for mosquito breeding and promoting malaria transmission. Therefore, there is ample need for seeking alternative methods of vector control.

OBJECTIVES

—Reduction in vector density.
—Reduction in disease incidence.
—Reduction in operation cost.
—Community involvement.

—Identification of the most cost-effective method of Environmental Manipulation Programme feasible for application at the village level.

RATIONALE

-- The malaria control measures currently applied have not been able to further reduce the number of cases and in fact the incidence of the disease has been rising steadily during recent years.
—Malaria cases have risen from 121 in 1976 to 2,347 in 1984 in the study area. Many of the imported *P. falciparum* cases are chloroquine resistant.
—The high cost and unavailability of a sufficient quantity of insecticides and high operational cost of spraying operations.
—Environmental risks and risk of development of resistance through the continuous use of more toxic insecticides, when vectors have developed resistance to cheaper and long lasting insecticides.
—Ineffective impact of insecticidal spraying because of the local custom of replastering during religious festivals.
—Increased irrigation and agricultural activity through many development projects.
—The community in this area is well acquainted with malaria control programme. Therefore, efforts should be made to use this aspect in order to promote more active participation of the community in spraying operations and Passive Case Detection.

OPERATIONS

Since long the NMEO has been interested in finding alternative and/or supplementary measures to help in the reduction of malaria incidence. Community participation was tried in at least the following three control methods:

(a) Simple environmental manipulation;
(b) Residual spraying operations; and
(c) Passive Case Detection.

Simple environmental manipulation

(a) The trial area

Dhanusha district of the Janakpur Zone in the central region is a representative area in the Terai belt (Fig. 2). The study area for application of environmental manipulation is situated in this district. The inhabitants of the area are of mixed Indo-Nepali race, mostly speaking Maithali language and practising Hindu religion. The main festivals are *Holi* (March), *Judsital* (April), *Durga Puja* (October) and *Diwali* (October). These interfere with spraying operations because of the general habit of white-washing and replastering the interiors of dwellings during festivals and other social

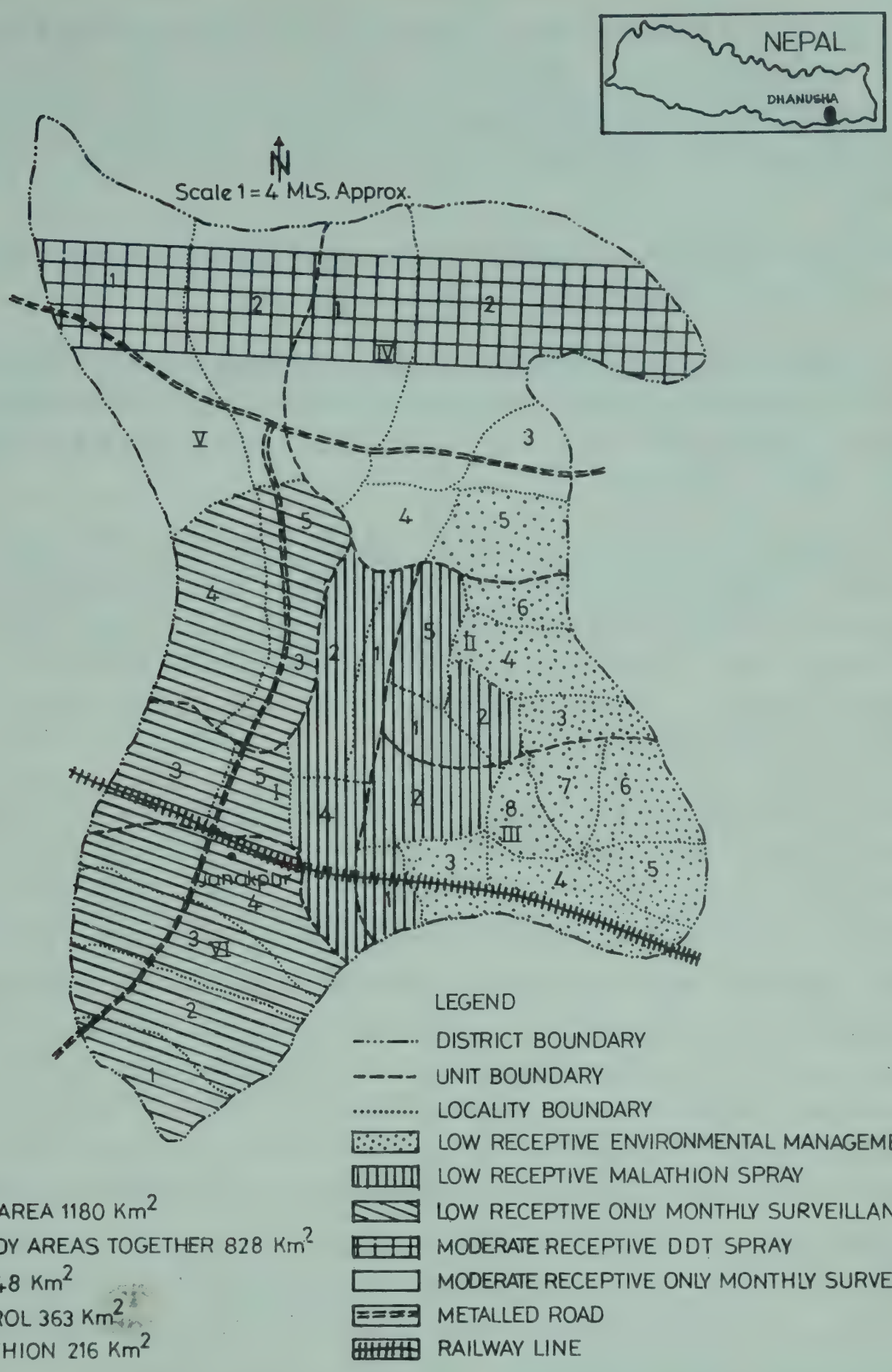

Fig. 2: Map of district Dhanusha showing epidemiological characteristics.

occasions. The people sleep outside during most part of the year specially during warm months.

Janakpur, being a sacred pilgrimage spot, attracts large numbers of pilgrims from all parts of India and Nepal during *Ram Navami* and *Bibah Panchami.*

An important aspect in the daily life of the inhabitants which also has an impact on the malaria situation is continuous and intensive movement of population between the plains and forest in the north, for different purposes

like collection of firewood and construction material like wood and thatch and for cattle grazing. The villages are compact and not far from each other and are accessible by vehicle during the dry season only. The houses are made mostly of mud with thatched or tiled roofs. Watch huts in the fields are common.

The famous Char Kosh Jhadi forest has been eliminated in the district due to extensive resettlement from the hills.

The Kamla Irrigation, Hardinath Irrigation, Deep Artesian Well Irrigation and Fisheries Development Projects are functioning in the Dhanusha district. A number of seasonal rivers with sandy beds traverse from north to south during most of the year.

The topography of the study area is plains intercepted by numerous dry seasonal riverbeds and a number of newly constructed irrigation canals from the above mentioned projects. Patches of swamps and seepage exist all along these canals. Some of the canals are also seasonal (branches of the Kamala Irrigation System). During the dry season the beds of these canals become extensive breeding places for mosquitoes.

The area is extensively cultivated and the main harvests are rice, maize and tobacco. Every village has a number of ponds of different sizes with irregular banks. They are used for different purposes like irrigation, washing etc., and are mostly covered by water hyacinth, hydrophytes and other aquatic flora.

The monsoon rains start from mid-June and end in mid-September. Though this seasonal rain washes out larval breeding sites in the riverbeds and canals, numerous breeding places in the low-lying plain land and borrow pits are created. The pre-monsoon period of March to May and the post-monsoon period of October to December with its favourable temperature and relative humidity increase the density of *Anopheles* and ensure malaria transmission.

The breeding sites for mosquitoes are banks of irrigation channels, water impoundments such as village ponds and dish ponds, open shallow wells, seepages and numerous borrow pits. During the monsoons the number of breeding sites increase and in the dry season a large number of depressions around the villages and houses become potential breeding sources. Rice-fields are also a major source of mosquito breeding during June and July.

More than 90% of the residents are engaged in agriculture and their economy depends on agricultural income. The products are mostly paddy, wheat, mustard and tobacco.

The study area has a population of about 1,17,000 and 22,000 houses scattered in 107 villages, with a surface area of 248 km^2.

Social and political structure of the community is based on the panchayat system which is well established even at the grassroots level. Each village panchayat consists of nine wards with approximately 1000 population in each

ward. The panchayat committee is constituted of nine members, one *Pradhan Panch* and one *Upa Pradhan Panch.*

In addition to the village panchayat organization, a number of class organizations and social workers committees also exist which facilitates voluntary community cooperation very much. For environmental manipulation and other aspects of the malaria control programme, malaria committees were formed in 14 village panchayats of the environmental manipulation area.

The district of Dhanusha has a problem of persistent malaria transmission, but, owing to the low vectorial capacity of *A. annularis*, malaria is hypoendemic. *A. annularis* is resistant to DDT. The malaria control programme activities include selective malathion spraying and surveillance activities. Though the spraying of insecticides is very selective, still it is hampered by various factors such as local customs and traditions and also non-availability of sufficient insecticides, high cost of insecticides, increasing operational expenses and vector resistance etc.

(b) The Control Area

For entomological and epidemiological assessment of the impact of simple environmental manipulation for source reduction, another area in the same district was selected as control. The control area consisted of two malaria units of 99 villages, 22,319 houses and 1,39,176 population. Case detection and treatment activities were performed on routine basis in this area as well. Entomological observations were carried out as part of a special entomological research study.

(c) Activities

(i) Completion of Geographical Reconnaissance

Information regarding the climate, rainfall, socio-economic and socio-cultural aspects and development projects were collected and the number of villages, houses and population represented in the district malaria office were updated. All the water reservoirs and impoundments were enumerated. The number and surface area of other potential mosquito breeding sources was recorded and mapped as far as possible. The initial activities for completion of Geographical Reconnaissance was done in April 1983 and in January 1984 it was updated (Table 1).

(ii) Community approach

In the last three decades, during intensive malaria control operations specially spraying and later on in case detection operations we have witnessed the cooperation of people in a number of ways. But the fading away of the urgency of malaria control and the monotonous type of activities coupled

Table 1. Record of G.R. for environmental manipulation (trial area)

Unit No.	Total localities	No. of villages	No. of houses	Population	Number of			
					Ponds	Depressions	Shallow wells	Artesian wells
2 Sabella	3	33	6122	35927	145	57	311	349
3 Ekrahi	6	61	11498	68567	324	107	588	646
4 Birendra Bazar	1	13	2283	12437	34	—	61	38
Total	10	107	19903	116931	503	164	960	1033
Control area 3 units	10	99	22319	139176	420	240	680	130

with the slackening of supervision etc., brought indifference and coolness in the community.

On the other hand the necessity for communities to solve their own problems and in order to elicit interest and a consciousness of self-reliance plus the appearance of technical and financial problems, compelled the executives of the malaria control programme to renew their efforts once again towards a community approach in a more democratic and scientific way.

(iii) Health education

The health education campaign was started in the first stage of the programme. The village panchayat heads and other members were contacted in order to acquaint them with the different aspects of disease control through environmental manipulation. The whole plan was discussed and their acceptance was sought. The result of this first contact was the creation of malaria control committees. Malaria committees were formed in 14 panchayats of the area. These malaria committees have five members each, under the chairmanship of an ex-officio *Pradhan Panch.* The malaria unit in charge worked as member/secretary and three other members were from different social organizations. In the second phase of the programme village elders were met in the presence of malaria committee members and the whole plan and objectives of the operations were explained. Posters were issued and slogans were painted on the outside walls of the houses, in important places. Talks and lectures in the schools and other congregations of villagers were organized. The whole malaria set-up in the area was reoriented in health education through the concerned section in National Headquarters and in regional malaria offices. Malaria field workers were given special health education training for continuous imparting of knowledge to the villagers on daily house to house visits. The initial health education activities took two months (April and May 1983) and continued thereafter also.

(iv) Simple environmental measures

Simple environmental measures that were within the capability of the local community resources and conditions, were as follows:

—Clearance of all marginal and surface vegetation from ponds.
—Filling or draining of useless small water collections.
—Clearance of marginal vegetation in the irrigation canal and repair of embankments where and when needed.

These activities started from the beginning of April 1983 to mid-June 1983 and were interrupted from mid-June 1983 to mid-September 1983 (monsoon season). They were resumed from mid-September 1983 and continued till the end of May 1984 again being stopped during the rainy season. The measures could not be continued for three years as planned, because of financial constraints (Table 2).

Table 2: Record of malaria surveillance

Year	1982						1983						1984					
	Total positives			Indigenous			Total positives			Indigenous			Total positives			Indigenous		
Month	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Jan	1		15	1		11	11		16	2		5	8		17	0		4
Feb	6		9	5		9	9		8	2		2	9		12	2		3
Mar	15		17	6		13	3		11	0		5	8		22	0		8
Apr	14		24	12		14	18		30	9		8	18		12	6		6
May	44		54	30		35	13		12	4		22	18		38	9		26
Jun	90		70	69		52	23		46	10		21	40		47	15		26
Jul	75		62	44		41	53		61	14		24	50		41	17		21
Aug	73		64	42		42	36		44	14		12	24		45	13		20
Sep	42		46	29		29	28		48	16		20	34		71	18		47
Oct	40		42	31		31	39		88	13		51	79		121	32		96
Nov	45		47	28		30	37		41	17		28	22		40	3		26
Dec	25		9	5		3	9		25	4		9	11		28	4		18
Total	470		459	302		317	279		460	105		207	321		494	119		301

A = Simple environmental manipulation area. B = Malathion spray area. C = Control area.

(v) Organization

For carrying out this programme, five labourers and one foreman were recruited and trained in March 1983 for each locality (10 localities in all). All the labourers were recruited from the local community as far as possible. The work of these teams was supervised by the malaria field workers in collaboration with the members of village malaria committees. The intention of employing labourers for the first year of the programme was to acquaint the local villagers with the type of work and it was intended to retain only two employed labourers for each locality in future for two years. The community was expected to carry out source reduction activities and the two employed staff to support collection of reports and do larval collections and serve more or less as a liaison between the malaria unit office and the village malaria committee. It was planned that after three years the community, through the village malaria committee, will take the responsibility. The malaria programme will supervise and deliver necessary technical support.

(vi) Epidemiological activities

All villages in the trial and control areas were visited once a month for case detection by malaria field workers. Presumptive treatment was given to all fever cases and all malaria positive cases were investigated epidemiologically and given radical treatment. The positive malaria cases were also followed-up for 12 months. The number of confirmed malaria cases and indigenous malaria cases in the pre-intervention year (1982) was nearly the same in both control and experiment areas. The measures of environmental manipulation started in April 1983. A reduction in the number of malaria cases and indigenous cases is observable in 1983. A total of 279 malaria cases were recorded from the experimental area as against 470 cases in the same area in 1982 and 460 cases in the control area in 1983. Similarly, there was a reduction of indigenous malaria cases in the intervention area in 1983 (34.5% reduction compared to 1982 and 50.7% less than in the control area). During 1984, although the environmental manipulation intervention could not be continued beyond July 1984, still the number of cases remained lower by 65% than the control area (Table 2).

Passive Case Detection was also performed in the above two areas. The number of PCD posts in the trial area was 28 in the manipulation control area.

(vii) Entomological activities

Entomological evaluation mainly focusing on indoor resting collection of adults by hand catches and larval collection were performed in a uniform manner in both sections (Tables 3 & 4).

The entomological evaluation also showed that the density of anophelines always remained low in the environmental manipulation area as compared to control area except in the month of September 1984 for indoor resting density

Table 3: Density of Anopheles mosquitoes in environmental and control area

Month & Year	Environmental manipulation area				Control area			
	Man hours spent	Per man hour density of all anopheles (No. coll.)	No. of dips	Density of all anopheles larvae per 10 dips (No. coll.)	Man hours spent	Per man hour density of all anopheles (No. coll.)	No. of dips	Density of larvae per 10 dips (No. coll.)
Jun 83	16	1.25 (20)	600	2.43 (146)	16	52.06 (833)	200	26.00 (523)
Jul 83	16	83.56 (1337)	500	2.34 (177)	16	39.00 (624)	740	3.40 (255)
Aug 83	16	47.68 (763)	550	0.94 (52)	16	150.25 (2404)	510	0.90 (48)
Sep. 83	16	35.12 (562)	500	2.12 (106)	16	59.50 (952)	600	1.80 (110)
Oct 83	16	10.75 (172)	500	0.68 (34)	16	57.38 (918)	600	1.20 (73)
Nov 83	16	13.50 (216)	550	1.05 (58)	16	42.56 (681)	780	2.20 (177)
Dec 83	16	1.94 (31)	500	0.04 (20)	16	30.56 (489)	680	3.40 (230)
Jan 84	16	2.06 (33)	500	0.66 (33)	16	43.75 (700)	410	2.10 (88)

contd

Table 3 contd...

Feb 84	16	9.00 (144)	500	0.84 (42)	16	60.37 (966)	410	1.20 (51)
Mar 84	16	6.19 (99)	500	3.04 (152)	16	49.62 (794)	520	1.90 (98)
Apr 84	16	0.94 (15)	500	1.58 (79)	16	46.62 (746)	670	2.60 (173)
May 84	16	1.93 (31)	600	0.65 (39)	16	58.12 (930)	510	15.20 (779)
Jun 84	16	13.50 (216)	720	1.54 (111)	16	45.93 (735)	190	7.80 (148)
Jul 84	16	—	—	—	16	45.06 (721)	220	2.60 (57)
Aug 84	16	34.50 (552)	600	5.43 (326)	16	53.68 (859)	503	1.40 (71)
Sep 84	16	54.50 (872)	700	1.47 (103)	16	1.75 (28)	280	5.30 (149)
Oct 84	16	31.69 (507)	700	14.45 (1012)	16	1.56 (25)	520	9.90 (516)
Nov 84	16	31.50 (504)	700	1.32 (93)	16	29.87 (478)	370	6.80 (252)
Dec 84	16	19.67 (314)	700	1.00 (70)	16	22.81 (365)	280	9.50 (266)

Table 4. Record of initial clearing of mosquito breeding sites in the three malaria units of the trial area

Unit	Number cleared			
	Ponds	Depressions	Shallow wells	Artesian wells
Sabella	127	2	263	329
Ekrahi	260	13	556	607
Birendra Bazar	32	—	60	33
Total	419	15	879	969

of adults and in October 1984 for larvae. An insignificant rise in density of larvae was also observed in the environmental manipulation area during March 1984.

COMMUNITY PARTICIPATION IN INSECTICIDE SPRAYING

People's involvement has always been determinate in the success of spraying operations. Indeed, the most arduous activity of removing household effects and preparation of rooms for insecticide application, providing water for making the suspension, etc., were important aspects of the involvement of villagers in spraying tasks. But mostly the villagers were interested in spraying because it eliminated other harmful insects like houseflies, cockroaches, poisonous wasps, bedbugs, flies etc., and when they found that these insects are no longer affected by spraying they became apathetic towards spraying although the insecticide would still have been very effective for the control of mosquitoes. Therefore, it became very necessary that the community be informed about the facts. This happened in the villages of the Terai in Nepal where three decades of insecticidal pressure was applied whether on total coverage (sixties and seventies), or on selective focal spraying basis (present decade). On the other hand day-to-day problems are encountered for recruitment of spraymen who objected to the pay scale and toxic hazards. To remove such obstacles no other way exists, except the active involvement of community resources.

Three villages were thus selected for a village-scale trial of using community resources for spraying operations in Unit 6, Ghorghas (Table 5).

All three villages were located in Unit 6 of Dhanusha district, in low-lying plains which have a number of water-logged depressions and extensive rice cultivation. During 1983 and 1984 these villages had a high number of malaria cases, which was unusual for the villagers since MEP started. Village communities were approached as described earlier and were not only motivated but also alerted through intensive health education activities. As a

Table 5. Spraying through community participation

Name of village	Population	Insecticide Ficam 100 gm sachets	Man days supplied by community
Ganguli	1293	341	36
Deopura	350	100	16
Ghorghas	2120	1000	80
Total	3763	1441	132

result, these villages agreed to contribute free labour and other auxiliary needs. The labourers who were to be given training (two days) and to be used in the spraying of their structures (two days) were thus provided. These local spraymen had their training under the guidance of the malaria unit in charge. Spraying of Ficam was implemented in April 1985 taking into consideration all aspects of this activity including safety measures.

The NMEO district malaria office provided equipment and material for spraying operations. The spraying concluded with good operational results. A number of indigenous malaria cases have been detected during 1985 after the spraying of Ficam.

COMMUNITY PARTICIPATION IN PASSIVE CASE DETECTION

This mechanism of case detection has long been practised in malaria eradication/control programmes. Some persistent programmes obtained good results in terms of economy and effectiveness while others, failed to secure benefits. In Nepal during the good old days of DDT miracles this aspect of case detection was a low-geared activity. It was strengthened during the recent years and we have realized that Passive Case Detection by community volunteers is not only productive and efficient but also much more cost-effective than it was thought to be. Therefore, under a regular plan an increase in the number of PCD posts is considered. The slides collected and positives detected by this mechanism in the country (excluding malaria clinics) for 1983–84 is given in Table 6.

Table 6. Passive Case Detection

Year	No. of PCD posts	No. of slides collected	No. of positives	Percentage of national total	
				Slides collected	No. of positive
1983	2,420	1,15,769	6,020	9.5	36
1984	2,716	1,46,319	12,290	12.0	47

The interest of the community can be further enhanced, if more emphasis is given to the promotion of health education.

Passive Case Detection (PCD) activity in malaria control programmes can be an important component and the basis for expansion of PHC services in future. But, the prerequisites for a successful outcome are sustenance, supervision and follow-up. The methods used to motivate the community are generally discussed in community participation for source reduction activities. We have found that the classes of the community involved in this type of activity are mostly school teachers, students and some other social workers. Doctors and physicians are cooperating on a small scale.

DISCUSSION

An effort was made to explore and promote the inputs of the village communities for control of malaria in Terai region of Nepal. The authorities were found to be interested in application of alternative and/or supplementary vector control measures.

It was also found that the malaria eradication infrastructure together with the political/administrative and social rural set-up in the villages are valuable assets. These facilities can be utilised to augment health education and to prompt the community for actual, active and sustained involvement in different aspects of the programme. The communities although not financially well-off took interest in the activities and were enthusiastic even about financial support.

The potential breeding sources of *Anopheles* are water ponds and seepage patches. They are well accessible and mosquito breeding can be reduced by simple environmental measures.

During the short period of an experiment in environmental manipulation (the experiment could not be continued because of financial constraints), the entomological and epidemiological findings were substantially fruitful although without noticeable results. Sustained efforts and judicious exploitation of community resources should surely promote efficient and cost effective vector control.

It is realized that due to diverse technical, administrative and financial problems, the need for comprehensive people's participation remains high, specially when the national health policy dictates Primary Health Care as a main objective and approach for Health for All by the year 2000.

There remains no doubt that the PCD component of case detection if organized and supervised serves well as a cost-effective and cost-beneficial method of malaria control as compared to active case detection and insecticide application.

The realization of the fact that the community should become self-reliant in vector control and disease prevention shows that intensive public health education is needed. The fact is that though most programmes are familiar with the impact and benefit of health education, they effectively absorb only a small fraction of financial input. Therefore, it is high time to reconsider the vector control policy with more emphasis on public health education and a firm integrated strategy at the community level.

Integrated Vector Control in the Context of Community Participation in Burma

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INTRODUCTION

In Burma the Vector-Borne Disease Control (VBDC) Programme was launched in April 1978 to encompass the control of four vector-borne diseases, responsibility for which had been previously vested in separate projects. These are malaria, dengue haemorrhagic fever, filariasis and Japanese encephalitis.

Malaria is still considered a major public health problem. The first People's Health Plan (PHP) for 1978 to 1982 gave first priority to malaria out of 51 priority diseases whereas in the second PHP for 1982–1986 it was second to diarrhoeal disease out of 56 priority diseases. In the present PHP for 1986–1990, now under preparation, malaria is again the first priority out of sixty listed diseases.

For the implementation of the malaria component of the VBDC Programme, the country has been stratified into five strategic areas, i.e., drug area, spray area, surveillance area, vigilance area and originally malaria free areas. This stratification was based upon the malaria prevalence, accessibility, the epidemiological characteristics, vector bionomics, results of previous anti-malaria activities, the development of the health infrastructure and the availability of resources.

Out of an estimated population of 35.9 million, 22.1 per cent lives in drug areas, 13.6 per cent in spray areas, 41.9 per cent in surveillance areas, 13.9 per cent in vigilance areas and 8.5 per cent in originally non-malarious areas.

The key approaches are case detection and treatment, malaria chemoprophylaxis in high risk groups and anti-vector measures utilising insecticides or environmental methods.

The malaria control activities in Burma are integrated with the basic health services at the township level and below. The actual implementation is by public health supervisors I and II supported by community health workers. The present linkage of the malaria control programme in the integrated areas is through the VBDC team located at the divisional/state and township level. The VBDC team is responsible for giving technical guidance and for monitoring and evaluating the implementation of the programme.

Dengue haemorrhagic fever (DHF) first appeared in Burma in 1970, initially being confined to Rangoon city until 1975 when it spread to other states and divisions. Since then cases have occurred in all parts of the country except Kayah and Chin states. The disease is cyclical with marked increases in cases every two or three years. The average number of cases per year is 2573.4 with 106.33 deaths and an average case fatality rate of 4.1% for these 15 years. The highest number of cases occurred in 1975 (6750) with 363 deaths and the lowest in 1973 (349) with 15 deaths. In 1985 there were 2629 cases with 134 deaths compared with 2323 cases with 39 deaths in 1984.

Aedes aegypti, the vector of DHF is extensively distributed in all parts of the country upto an altitude of 3000 feet above sea level.

Control measures such as source reduction involving the community, ULV focal spraying around clinically suspected cases, larviciding with one per cent temephos sand granules applied to domestic water storage containers are all being carried out. Health education activities are conducted utilising the mass media.

In Burma filariasis is caused by noctural *Wuchereria bancrofti* which is transmitted by *Culex quinquefasciatus*. Previously the disease was confined to urban areas but it has now slowly spread to the rural and hilly regions.

Filariasis is principally an environmental sanitation problem. The vector *C. quinquefasciatus* breeds in blocked drains with stagnant polluted water, septic tanks, cesspools and pit latrines. Its control has been practised over the past 20 years in 16 townships in Rangoon division by anti-larval measures using fenthion 50% E.C.

The micro-filaria carrier rate is 2.0 per cent for the country. The vector is still susceptible to fenthion but there is some degree of tolerance now. There is no data on incidence of clinical manifestation due to filariasis.

Japanese encephalitis appeared for the first time in Burma in 1974 and from that time until 1979 there were 188 cases and 92 deaths. Since 1980 no cases have been reported from the country. Country-wide surveys of the distribution of the mosquito vectors are made on an *ad hoc* basis. In the known

areas of previous cases portable space spraying machines and malathion are maintained to enable VBDC team to take immediate action. Some vaccine is also in stock.

INTEGRATED VECTOR CONTROL

Although eradication of a vector-borne disease is the ideal solution, but rightly or wrongly the concept of eradication has been abondoned, and control to "an acceptable level" is the order of the day. This has largely led to a reduction in overall activity, but vector control with insecticides retains its prominence.

However, with the appearance of resistance and the necessary switch to less efficient and shorter presisting compounds, this is becoming more and more expensive. Also, there is undoubted growing opposition to their use not only by environmentalists but also by the householders themselves. The trend must, therefore, be away from sole reliance on chemical control and towards the integration with other methods be they environmental, biological, genetic, therapeutic or educational.

WHO[1] defined integrated vector control as "the utilization of all appropriate technological and management techniques to bring about an effective degree of vector suppression in a cost effective manner". This has resulted in more widespread interest and concern with how to design, implement and sustain integrated vector and disease management programmes as a part of primary health care, as advocated by the nations of the world in the Declaration of Alma Ata, 1978[2].

COMMUNITY PARTICIPATION

The primary health care approach has now been widely adopted by the health services. The vector-borne disease control programme is also included. A unique feature in Burma is the immense scope for utilizing community participation through people's councils, Lanzin youths and other voluntary organizations in vector control operations.

In Burma the hierarchical steps in all the political, administrative (including health administration) and voluntary mass and class organizations are as follows; central, states & divisions, townships, wards & villages and streets & hamlets. In each level there is; (i) political component (party), (ii) general administrative component (council), and (iii) health department.

To achieve the involvement of the community in disease vector control to the fullest extent, individuals, families and communities must be progressively trained, informed, educated, motivated, organized and supervised.

It is the responsibility of the central health administration to consult the parallel levels of political, council and voluntary organizations at the central

level to carry out pre-planned activities to be conducted by community participation. The respective central organs will give directions to their next level thereby circulating the necessary instructions downwards right to street and hamlet levels and thence to individuals or families.

The various political, administrative and social organs are important and can excercise considerable influence on the community in their respective localities. They can organize the community to perform and implement the disease vector control programme. The health department personnel could serve as advisers for such activities and the health department also could provide the necessary resources.

The Burmese administration has formed core committees at the local level performing this type of task by community participation. This committee usually includes members from the party and council who are responsible for health and social welfare. Other members are from the health department and are responsible for technical aspects. Directives and consultations would be towards establishment of inter-sectoral linkages, especially among various mass and class organizations belonging to political, governmental and social units. Inter-sectoral coordination with other government agencies could also be done through this committee.

COMMUNITY PARTICIPATION IN VECTOR CONTROL

Community participation in vector control has been conducted in Burma over a number of years. Many of these activities were carried out on *adhoc* basis, results of which were not published. Unfortunately, owing to a shortage of personnel, a proper follow-up of these activities was not obtained. Nevertheless, the activities were carried out and information gained by these performances was presented.

Malaria vectors

In 1977, community participation in the reduction of anopheline breeding sites in Sittwe, Rakhine state was effectively carried out. *A. annularis* was found breeding in large numbers in blocked streams. With the collaboration of the local population, the blockages were removed once a week for three weeks, thereby ensuring a free flow. A marked reduction in *A. annularis* densities was noticed. Similarly, *A. annularis* breeding in ponds and ditches covered with the water grass, *Ipomes aquatica* was observed in 35 ponds, 13 common drains and two creeks around Sittwe. With health education imparted to the people and with two cleaning campaigns, a drop in fever cases was observed and slide positivity rate fell from 11.3% to 8.6%.

General sanitation, drainage of water bodies and improvement of housing has recently been shown to have improved the malaria control activities in the central part of Burma near Mandalay in Patheingyi township. An intensive

programme of community participation and health education was carried out there. Reduction of the movement of people from and to the forest zone, proper construction of houses such as proper walling on all sides (resulting in improved contact of anophelines with DDT spray on the wall), early detection and treatment of malaria cases has brought the disease under considerable control.

In 1983, in Oketada and Natsin villages in Paung township of Mon state, malaria control has been carried out using bio-environmental management by community participation. For example, a natural stream was passing through the middle of the village in such a way that water was eddying and stagnating because of curves. There were also water patches with thick vegetation cut off from the main stream during dry season. These serve as breeding sites for malaria vectors. The local malaria inspector organized the villagers to train and embank the stream so that the stream became straight with swift flowing water. Vegetation was cleared. In the next year, it was found that the malaria problem went down remarkably. In the latter village there was very thick vegetation. There was no systematic housing plan. The same malaria inspector persuaded and organised a community participation programme by requesting the villagers to clear vegetation and to replan the houses in a systematic way. The malaria incidence has been reduced and this status has been maintained up to now by repeating the same activities.

In 1984, community participation in the reduction of anopheline breeding sites in Magyikan Village, Hlegu township, Rangoon Division was carried out. *An. minimus* was found breeding in the streams covered with thick vegetation. With the collaboration of the local population vegetation was cleared. A marked reduction of *An. minimus* densities was noticed and a drop in malaria cases was observed. Similar activity continued at the same locality during 1985. Follow-up entomological observation revealed that this locality produced surprisingly few vectors considering the severe outbreaks experienced in the area 2 years ago.

DHF vector

In Rangoon division the emptying, filtering and covering of water containers and source reduction campaigns in *Aedes aegypti* larval control has been carried out in some selected wards in 39 townships with the help of mass and class organizations.

Although much effort is still required to bring about successful community participation for the control of *Aedes aegypti* larvae in the city of Rangoon, this type of activity was found to be successful in Kemmendine, Mayangone, North Okkalapa and Thaketa townships.

In Moulmein township, Mon state large-scale larvicidal operations with temephos 1% sand granules was carried out utilizing community participation

in the control of *Aedes aegypti* larvae during 1981–1984. Results showed a dramatic drop in the house and Breteau indices following application. A study carried out on vector control by health education alone showed a reduction of the house index from 50% to 15% during the first week of the trial. Similarly, Breteau indices were reduced from more than 100 to less than 50 and even to 15–25 during certain periods.

In Rakhine state DHF cases have occurred since 1975, but only on a small scale. In 1982, there was a sudden increase of DHF cases in Sittwe town. The state health authority immediately consulted the situation with the state council which took prompt action in organizing the community to conduct anti-larval measures.

A water emptying campaign was carried out throughout the town. Health education and motivation was done by having group talks, lectures etc.

A similar type of community participation continued in 1983, 1984 and 1985. Over 2,30,000 people were educated, motivated and involved in commuity participation activities. A summary of case occurrence in this town during 1975–1985 may be seen in Table 1.

Table 1. Incidence of DHF in Sittwe town

Year	Cases	Community participation
1975	109	—
1976	32	—
1977	6	—
1978	17	—
1979	8	—
1980	20	—
1981	63	—
1982	325	+
1983	145	+
1984	26	+
1985	16	+

Filaria vector

To substitute effective integrated control programme for filariasis, environmental cleansing campaign with active community participation has been introduced in Rangoon with the coordinating committee consisting of Rangoon Health Division, Party council, political bodies, Rangoon Development Corporation and VBDC personnel.

The main aims were antilarval measures carried out by community participation in the form of a mass cleansing campaign, cleansing of drains, filling of ditches, creating regular flow of water and preventing stagnation or contamination of water from the drains.

The procedure adopted for the vector control programme for filariasis was by selecting a study area in Mingalataung Nyunt township of Rangoon, for a period of one year.

The *impact* of the short term study is shown below:

Type of study	—Mass cleansing campaign with active community participation.
Period covered	—December 1983—December 1984.
Type of exercise	—Every week cleansing campaign with, active community participation for first six months. Every fortnight for second six months.
Evaluation done	—Every three months.
Population of township	—1,10,595
Population coverage	—6,080 (55%)

Findings

(a) Epidemiologically	—Microfilariaemia rate	
	Before (in 1983) mf—4.5%	
	After (in 1984) mf—1.0%	
(b) Entomologically	—Density of *Culex*	
	quinquefasciatus 11.86/man hour	
	Before (1983)	Infected 1.29%
		Infective 0.27%
	After (1984)	Density 8.9/man hour
		Infected 0.44%
		Infective 0.0%

CONCLUSIONS

It will be seen from these trials that the outcome of various vector control operations was very encouraging.

Involvement of the entire community for the success of disease vector control became more significant specially in those control programmes which revolved around the immediate vicinity of man and his environment.

Although for the time being chemical control will continue to be used for the control of vector-borne diseases particularly during epidemics and large-scale infestations, it is recognized that there is a great deal of scope for the development of comprehensive vector control operations consisting of appropriate combinations of environmental, biological and chemical methods for the suppression of vectors.

However, a majority of the alternative methods such as bio-environmental and biological measures are still in a phase of development and research. Moreover, none of these measures are likely to succeed without the active cooperation of the public and coordination of activities of various bodies of the Government such as the Department of Agriculture, City Development Committee, the people's councils and the youth organizations.

Lastly, for all integrated disease vector control programmes; cost-effectiveness, operational and financial feasibility, simplicity and safety for local application by the community must be carefully considered before being carried out.

The Vector-Borne Disease Control Programme in Burma will endeavour to incorporate these concepts.

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SOCIO-ECONOMIC AND CULTURAL PERSPECTIVES

Fund-raising Activities for Community Participation in Malaria control through Primary Health Care— A Papua New Guinea case

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MALARIA CONTROL PROGRAMME IN PAPUA NEW GUINEA

Until recently, in Papua New Guinea, the malaria control programme was conducted through a vertically integrated system whereby the director of the programme in headquarters had full control of his field staff down to the lowest level. This centralized system did not effectively coordinate efforts at the provincial or district level, leading to inefficient use of resources and lack of flexibility in responding to different provincial priorities or conditions[1]. This system has now been replaced by a decentralized system whereby each province or district can decide their own needs and priorities and direct their resources towards that goal.

In the light of the national health policy to develop a Primary Health Care system, the malaria control service has been decentralized and the programme has become the responsibility of the provincial governments as from the beginning of 1983[2].

Malaria control measures applied so far in Papua New Guinea are DDT residual house spraying, antimalarial drug distribution, antilarval activities including the use of larvivorous fish *Gambusia affinis* and chemical control, source reduction activities such as drainage and land filling, the use of mosquito nets, and so forth. These measures are further promoted by the Primary Health Care system.

COMMUNITY ORGANIZATION AND PARTICIPATION

All the communities in Papua New Guinea used to be self-reliant and self-sufficient before it was colonized. Since the colonial days, however, the community people have become dependent on the government and have lost their traditional spirit of self-reliance. The government handouts and a high level of participation in the formal sector of the economy through wage earners and business activities have made it difficult to encourage people to work without pay on projects which are seen as government responsibilities. As a result, Primary Health Care is interpreted to mean that villagers tell the government what they want and the government installs it. This is obviously not the intent of Primary Health Care[3]. Such a case has occurred recently in a New Ireland Province PHC pilot project area. In a meeting with the village development committee leaders, one of them raised the question that the government should provide the materials to install the latrines in his village. The other leader objected to it, and criticized that it was the very way of thinking in the colonial days, and that their ancestors had done everything by themselves before the colonial days. All the other leaders were quiet.

Most of the Papua New Guinean villages consist of "wantok" who share the same sociocultural traits including language, customs, behavioural patterns and life style. Despite the prevailing "wantok" system, however, the village organization and leadership patterns which enormously affect community involvement are different from area to area even within the same region, province or district. In coastal areas of the Central and Milne Bay Provinces where the writer visited, for example, having frequent contacts with outside world, the villagers are easy to approach and no particular traditional strong "big-man"* exists in a village. In the Highland areas, however, living in isolated remote bush for thousands of years, the villagers are exclusive even to the neighbouring competitive villagers. Their traditional "big-menship" is so strong that no outsider can approach an individual directly. Similarly, no villager could approach government agency directly without getting the approval of the "big-man". Therefore, to mobilize community interest and involvement, health personnel should first contact the "big-man" of the community and gain his support[4].

There may be various reasons for poor community participation in malaria control through primary health care. In many trial areas, those who volunteered as DDT spraymen complained and demanded payment. For instance, in Lake Kopiago area of the Southern Highland Province, twenty men were selected to be voluntary spraymen early in 1985. Four of the spraymen were selected from each council area to represent the community.

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*"The attainment of big-man status is the outcome of the series of acts which elevate a person above the common herd and attract about him a coterie of loyal, lesser men"[4].

They were trained for one week before going out spraying structures. As the spraying continued on for three weeks, the number of spraymen's attendance dropped down each day. Finally, at the end of the third week, there were only ten spraymen, when the spraying was completed[5].

In a New Ireland PHC pilot project area, for another example, the malaria control programme focussing on DDT spraying had been successful during the initial two years of community participation. Since then, however, up till now there has been a fall and slackness in community participation. Many village development committees did not attend to all the households to collect the 50 Toea fee which is to be paid to village volunteer workers. The village people refused to volunteer workers. The village people refused to volunteer as spraymen because they could not get a share of the 50 Toea per house. Spray team did not spray the village without a volunteer. Malaria control programme paid two weeks' salaries to the spraymen. If this continues in future, the supervisory team will ask to call off the operation until the villagers cooperate.

In other areas after so many years of spraying with little effect, villagers are understandably reluctant to allow spraymen into their homes. In addition, an apparent increase in bedbugs and cockroaches and the possible poisoning of household pets bring the refusal rates to near 100% in some areas. Obviously, the spraymen cannot force their way into the houses, but spraying only 20-40% of houses in a village is a useless exercise which wastes everyone's time and money.

Most village people spend most of their time outside their house. Sometimes they spend nights in the garden or fishing and evenings are generally spent on the verandah where one can socialize with neighbours. Thus, even a successful spraying programme may have little impact on the transmission cycle.

We can see that community participation is very limited in local health system. The western medical system is seen as something rather remote from community values. It is also seen as something provided by the government and not as something which requires active support and participation at the village level.

Keeping such reasons for poor community participation as seen above in mind, it is urgently needed for the planning and implementing authorities to understand the continuity and change of behavioural patterns and ways of life of the community people to find out an appropriate approach in malaria control in the context of social, cultural, religious, political and economic aspects of the communities involved. Even though the principle of primary health care is the same in all areas of the world, the approaches to implementation must be different according to the different behavioural patterns, ways of life, ecology and epidemiology of the local community.

FUND-RAISING ACTIVITIES

Since a primary health care development project was initiated in the New Ireland Province in 1981, various field trials on malaria control in the context of primary health care have been conducted in other provinces such as Southern Highlands Province, Milne Bay Province and Central Province.

In Southern Highlands Province, Lake Kopiago is currently in the process of malaria control as part of Primary Health Care. In 1983, the Health Extension Officer has started there a network of Village Development Committees (VDC) to map out their priorities for Primary Health Care. Malaria has been the impetus for the formation of VDCs. Some examples of these committees' fund-raising activities are as follows[5]:

(1) With the Primary Health Care concept in mind, one community has formed a group of people of 14 members. They go around, organized as a working group. People hire them for 80 Kina a day and the money goes into their account. This is a good example of social and economic development.

(2) The village health aide has been paid by the community 7.10 Kina every month. This is a good response of community participation for their own health well being.

(3) Another committee raised 1500 Kina from selling the community vegetables in the market. The money was used to build APO's house with a water tank so that the community can use safe water for drinking.

(4) During the spraying operation, 1-22 May 1985, twenty men were selected to be voluntary spraymen. They were trained for one week before going out spraying structures. The spraying coverage by area was 98% and 99% of the population was covered. The community people participated very well in getting their houses ready, fetching water, and waiting around their houses until they were sprayed.

Based on the experience in Lake Kopiago, people in other areas can be approached to form VDCs and begin malaria control programmes as part of Primary Health Care. Koroba, Komo, Pimaga, and Erave are potential areas for such programmes in Southern Highlands Province of Papua New Guinea.

The data on which this paper was based was collected during the field visits in August-September, 1982 and July-August, 1985 for the development of malaria control field projects in the context of Primary Health Care and TDR/SER/WHO site visit.

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Control of Dengue Haemorrhagic Fever and Community Involvement in Indonesia

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INTRODUCTION

In Indonesia, dengue haemorrhagic fever (DHF) was reported as a new disease (for the first time in Jakarta and Surabaya) in 1968, 15 years after its authentic recognition in the Philippines in 1953[1,2]. During the 1968 outbreak a total of 57 clinical cases and 24 deaths were detected. The number of reported cases since then increased each year, and the highest numbers of cases were recorded in 1973 (10,189 cases), 1983 (13,895 cases) and in 1984 (12,710 cases). In 1983 the disease spread to 21 of the 27 provinces and to 162 out of 300 regencies or municipalities (Table 1 and Fig. 1). Since 1979, DHF cases were reported annually in 18 provinces[3]. No cases have so far been reported from the Province of Timor Timur. At present, the disease is endemic not only in large cities but also in small towns, and has spread to certain villages where the population movement and density is considerably high. On the other hand, DHF is still absent in some cities, although dengue virus transmission occurs in those particular areas.

The objectives of the national DHF control programme are, (i) to reduce case fatality through early diagnosis and proper case management; and (ii) to reduce morbidity and prevent the spread of the disease by control of

Table1: Number of reported cases of DHF and deaths in Indonesia 1968–1985†

Year	No. of cases	No. of deaths	CFR (%)	No. of provinces reported	No. of regencies reported
1968	58	24	41.3	2	2
1969	167	40	23.9	3	7
1970	477	90	18.8	4	8
1971	267	40	15.0	3	7
1972	1,400	135	9.6	4	11
1973	10,189	470	4.6	10	67
1974	4,586	180	3.9	10	69
1975	4,563	368	8.1	19	89
1976	4,548	214	4.7	19	93
1977	7,826	320	4.1	18	112
1978	6,989	384	5.5	20	125
1979	3,442	165	4.8	23	105
1980	5,007	243	4.8	23	115
1981	5,809	231	3.9	24	125
1982	4,665	255	4.7	22	142
1983	13,875	491	3.6	21	162
1984	12,710	382	3.0	19	160
1985†	13,558	460	3.4	19	155

†Source: CDC, Min. of Health R.I.

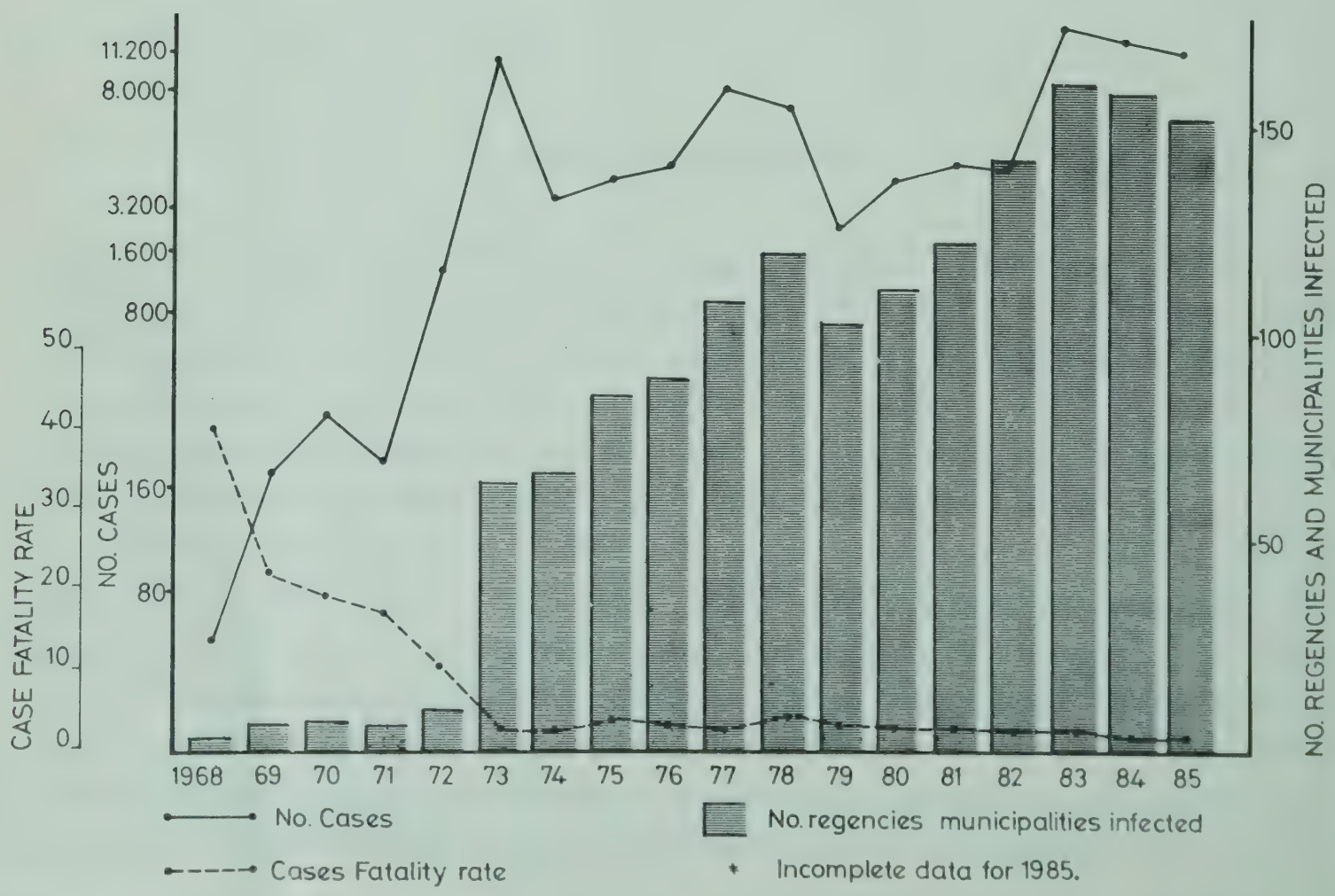


Fig. 1: Number of DHF cases, fatality rate and number of regencies/municipalities infected in Indonesia, 1968-1985*

epidemic/outbreak and vector control in endemic areas through community participation.

REDUCTION OF MORTALITY

The main inputs for the reduction of mortality are training of medical officers and nurses, and facilitating regional laboratory services with equipment, supplies and a health education campaign (Fig. 2).

The training of medical officers on diagnosis and case management started immediately after the first epidemic in 1968, long before the institution of the Subdirectorate of Arbovirus Disease was formed in the Directorate General of Communicable Diseases Control (CDC) in 1974. The training was initially assisted by WHO consultants mainly for research scientists and medical officers in teaching hospitals and for programme officers in Jakarta and several other big cities. Since 1975, when the national DHF control programme was initiated, a series of workshops and training courses were annually held by CDC for clinical and control personnel at various levels including medical officers at health centres. During a period of 10 years (1975-1984) about 4,000 medical officers and over 700 nurses were trained on various clinical problems of DHF (Table 2). This resulted in the drastic decrease of case fatality rate (CFR) to 3% in 1984 from 41.3% in 1968 (Table 1 and Fig. 1). In addition to the above workshop and training, in the past two years, refresher training courses were organized in different localities for instructors, each lasting for three days, where each of the 27 provinces was represented by one epidemiologist and one pediatrician. From 1986 onwards, the instructors will, in turn, train medical officers at regency levels for the case management of DHF in their provinces.

Guidelines on diagnosis and case management were published in 1981 and distributed to all medical practitioners throughout the country. In 1984, general guidelines for nursing of DHF cases were prepared by a group of experienced nurses to further improve the care of DHF patients by nurses in the hospitals.

To support accurate diagnosis by medical officers at various levels, laboratory services have been strengthened in endemic areas by establishing 15 regional laboratories.

In 1984, 7,759 (61%) specimens were examined out of 12,710 cases reported. Out of these, 3,408 (44%) were serologically confirmed[4]. As in other diseases, the earlier the patients consult the hospitals, health centres or doctors, the better are the chances of their recovery. It is believed that in Indonesia, health education campaign through different avenues (such as TV, radios, volunteers, etc.) may have motivated the people for early consultation in hospitals, health centres or with private practitioners. This input from the community may contribute to the reduction of mortality, especially in DHF, where the risk of shock is considerably high.

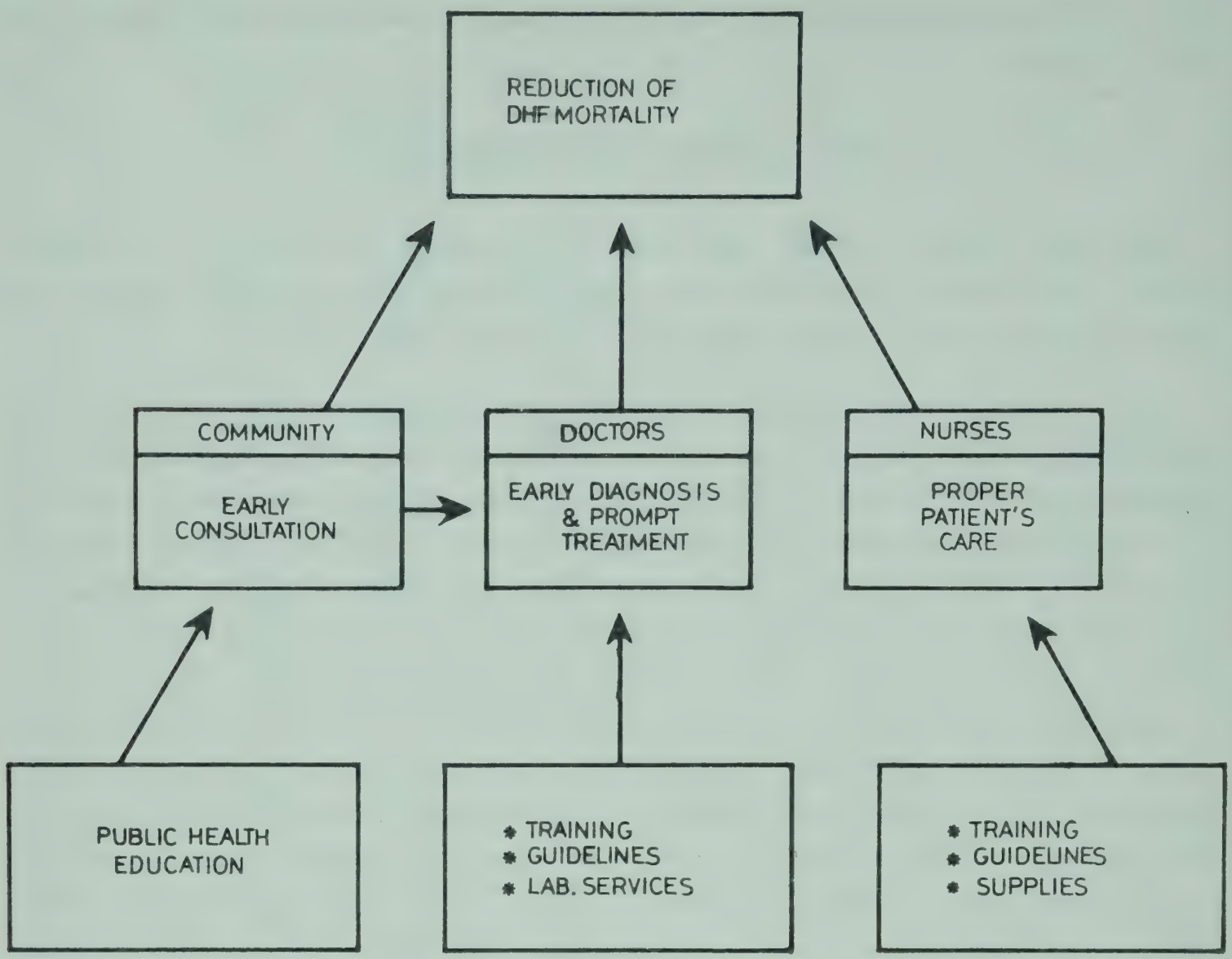


Fig. 2: Strategy for reduction of DHF mortality in Indonesia.

Table 2: Training and workshops for medical and vector control personnel on diagnosis, case management or epidemiology and control of DHF in Indonesia, 1975–1985†

Year	Subject	Medical Officers	Nurses/paramedical personnel
1975	Case management	60	0
1976	Case management	50	22
1977	Case management	0	32
1978	Pathology, Diagnosis, Treatment	50	25
1979	Clinics, epidemiology, control	468	0
1980	Case Management and Vector Control	164	61
1981	Workshop on DHF control	98	134
1982	Clinics, epidemiology, control	424	29
1983	Case management and workshop on DHF control	909	209
1984	Case management and DHF control	1,067‡	0
1985	Case management and DHF control	804	279

†Source: Subdirectorate Arbovirus Disease, CDC.
‡Including nurses.

PREVENTION AND CONTROL

All the basic activities for the control and prevention of DHF have been carried out under the network of general health services in the context of PHC.

Today, the activities undertaken for DHF vector control include; (i) mass fogging during epidemics or focal fogging in areas of 100 m radius of DHF case dwellings, (ii) mass larviciding during epidemics and in highly endemic areas, (iii) source reduction by the community (Table 3 and Fig. 3).

Epidemic control

Pest control of DHF in Indonesia was conducted in 1973 for the first time when two cycles of malathion ultra-low-volume (ULV) aerial spraying were done during the epidemic in Semarang in 1973[5] and in Manado in 1974[6]. Similar application of malathion was also made in Palembang in 1980 where aerial spraying was followed by mass larviciding of 1% temephos sand granules[7]. Unless the epidemic is large as in these 3 cities, most of the smaller and localized outbreaks are being controlled by two cycles of mass malathion fogging/ULV ground application together with mass temephos larviciding in the areas affected.

Mass fogging or anti-adult measures are usually carried out under the supervision of Municipality or Regency Health Office/CDC Unit, whereas larviciding is done by volunteers under the guidance of health officers at Health Centres.

Focal control

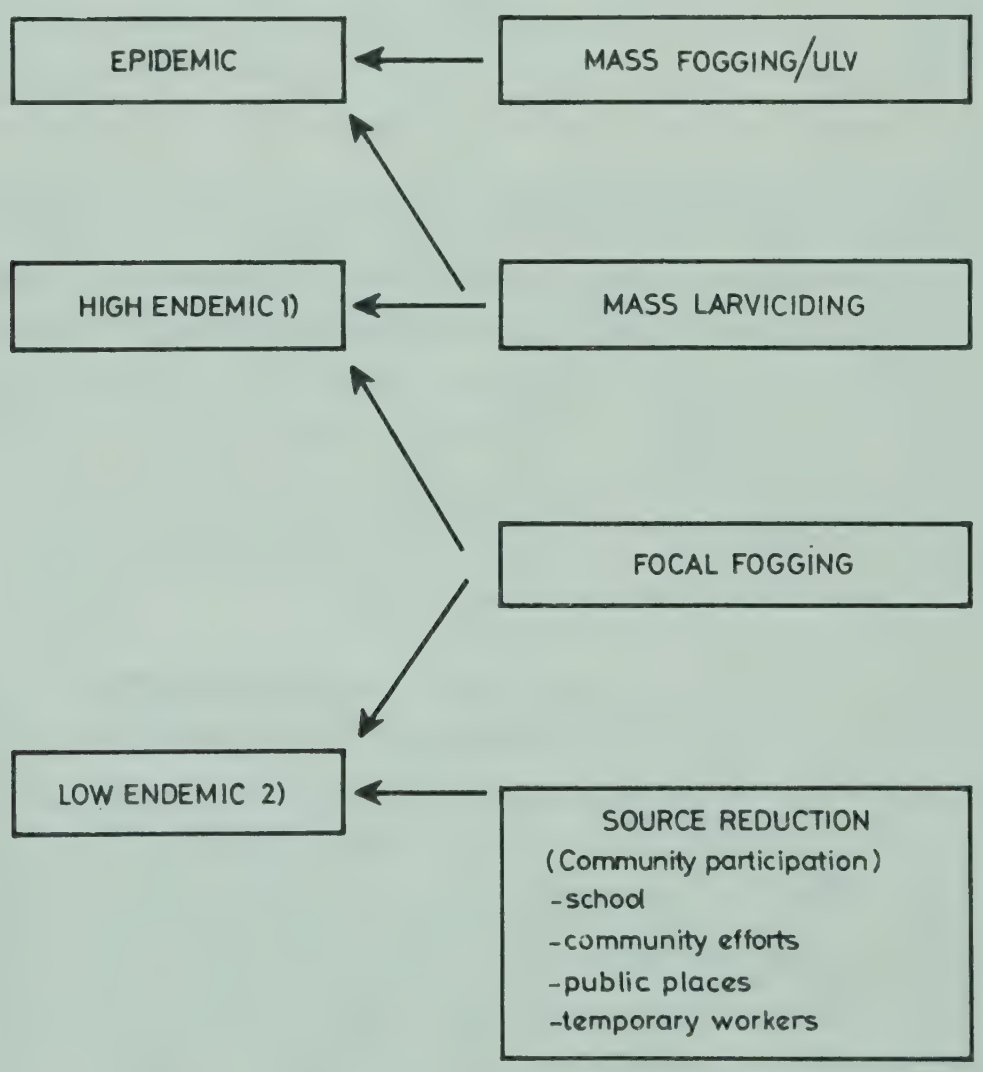
Malathion fogging supported by temephos larviciding is applied in an area of 100 m radius of each reported case of DHF. Schools are also included when the cases are among school children. Today, there are a total of nearly 900 spraying machines and 17 ULV (jeep mounted) distributed to all endemic areas. Each regency has been provided with a vector control team with at least two swingfogs, in addition to a supporting team at the Provincial office. During the past 10 years (1973—1983), over 4 million houses were sprayed with about 120 kilo-liters of 96% malathion[3].

In several highly endemic areas, due to the shortage of supplies and equipment, not all suspected DHF cases were covered by these focal measures. Priority is given to cases with fatal or dengue shock syndrom (DSS) and other severe cases with suggestive clinical signs and symptoms. For instance, in 1984, 40% of total DHF cases reported in Jakarta Municipality were not treated by focal measures. However, no additional cases were reported from the area of 100 m radius from the patient's residence during the period of observation lasting for at least one year (Syatar Malik, personal communication). Similar observations were also reported from most endemic areas of other provinces. These facts suggest that such a measure in a limited area must be regarded only as a psychological palliative as stated by WHO[8], though it has a certain scientific merit[9]. To make this focal measure more effective, since 1985 health education is carried out prior to malathion fogging to the householders of 100 m radius of DHF case's residence and followed by

Table 3: Activities for DHF vector control and prevention in different endemic areas in Indonesia

ACTIVITIES	DHF ENDEMICITY			
	Epidemic	High endemic	Low endemic	Non endemic
BY GOVERNMENT				
Mass fogging	+	−	−	−
Mass larviciding	+	+	−	−
Focal fogging	−	+	+	−
Health education	+	+	+	+[3]
BY COMMUNITY				
Source reduction	+[1]	+[1]	+[2]	+[4]

[1]For all water receptacles outdoor which are not treated with larvicide.
[2]Intensified source reduction by temporary workers *or* organized source reduction by schools, community efforts, public places.
[3]Health education through mass media.
[4]Voluntary source reduction by individuals who are motivated.



1) HIGH ENDEMIC: - Incidence > 10 per 100,000
- B.I. > 20

2) LOW ENDEMIC: - Incidence < 10 per 100,000
- B.I. < 20

Fig. 3: Prevention and control of DHF in Indonesia—strategy for reduction of morbidity (vector control measures).

source reduction organized by the chiefs of "RK" and "RT" (RK and RT are population subdivisions consisting of 300 and 30 families respectively).

Mass larviciding

Since 1980, in highly endemic areas where DHF occurs annually, mass application of temephos is usually made by trained volunteers, to prevent the expected highest transmission season. The smallest administrative unit for this measure is "kelurahan" (village) consisting of 3–5,000 premises. The highest administrative officials are usually elected as honorary campaign managers, and the field operation of larviciding is technically guided by paramedical personnel of Health Centres[10].

Health education is always conducted prior to larviciding in order to involve the community in source reduction by cleaning up temporary or non-essential receptacles and preventing *Aedes* breeding in water jars.

A serological study in Sidoarjo, East Java, in 1983 showed that the transmission rate of the dengue virus was reduced to 36% of the pre-level treatment in contrast with the increase of 110% in the control area[11].

During the past five years, the use of 1% temephos SG was about 400 MT with the highest consumption of 119 MT in 1983, when 2.5 million houses were covered by 1,10,000 volunteers (Table 4). It is estimated that due to the shortage of larvicide, mass larviciding usually covers not more than 30–40% of endemic areas in many regencies or municipality areas. Therefore, mass larviciding is usually limited to highly endemic villages selected on the basis of DHF incidence. In Yogyakarta and other cities and towns of Indonesia mass larviciding reduced the larval density to almost nil for a two week period after larviciding. But thereafter, the density increased gradually upto 50% of the pre-treatment level, three months after the application[12]. Since the last two years, on the basis of this experience, the areas covered by mass larviciding were reduced in some provinces in order to obtain 2 cycles per year or more of

Table 4: Number of houses covered and volunteers involved and amount of temephos 1% SG used in mass larviciding campaign, in Indonesia, 1980 to 1985

Year	No. of provinces	No. of municipalities	No. of houses†	No. of volunteers	Amount of temephos‡
1980–1981	1	1	417	3,781	23.2
1981–1982	14	37	1,347	34,660	91.4
1982–1983	20	59	2,346	1,10,005	119.2
1983–1984	21	84	2,482	86,104	110.8
1984–1985	26	63	1,050	38,449	45.7

†No. of houses covered in thousand.

‡Amount of temephos 1% sand granules used in 1000 kg.

this treatment (depending on the duration of the transmission season) in the most highly endemic areas. Two temephos applications, one before and the other 2–3 months later were found sufficient to prevent the expected increase in DHF cases in areas where the transmission season is the monsoon.

Source reduction

It is realized that insecticide application has a limitation for long term DHF vector control. Efforts to encourage community participation for source reduction have been initiated since 1975. Health education materials such as leaflets, posters, booklets, slides, films, etc., were distributed to the endemic areas. However, in most instances it was usually conducted with limited guidance, monitoring, and supervision. Since the last 5 years, different activities were initiated in many areas to obtain the most appropriate community approach for source reduction.

School approach

In Indonesia, about 40-50% of the total population is in the age group of 0–15 years and nearly half of them are students attending elementary and junior secondary schools. Most of the primary schools are provided with at least one teacher responsible for health education, who is technically assisted by Health Centre officers. It is known that schools, like other public places, are the main foci to spread and promote local transmission of DF/DHF. A survey in 1984 of the primary schools in five cities i.e., Padang (Sumatra), Jakarta, Karawang (West Java), Pekalongan (Central Java) and Yogyakarta showed that 64% of the schools harboured *Ae. aegypti* larvae, whereas at the homes of the children Breteau Index was 60%[13]. A total of 1,00,000 flip charts (of which 90,000 were donated by UNICEF) were distributed to all primary schools in endemic areas during the last three years. In a preliminary study in Pekalongan (Central Java), following a series of health education lectures to teachers and students, Breteau Index in school compounds and in school children's homes are reduced by 43% and 51% respectively as determined by a larval survey six months after initiation of the study (Table 5).

Table 5: *Aedes* indices determined before and after source reduction campaign in Pekalongan, 1985

	Months of survey	No. of premises examined	No. of containers examined	No. of containers with larvae	CI†	BI‡
School compounds	July 1985	133	391	99	25.3	74.4
	Dec. 1985	133	380	56	14.7	42.1
Students' houses	July 1985	266	653	77	11.8	28.9
	Dec. 1985	266	590	51	8.6	19.2

†Container Index.

‡Breteau Index.

On the basis of this experience, in August 1985 guidelines for source reduction by school communities were introduced by VBC/CDC and the Subdirectorate of School Health. They consist of source reduction or prevention of mosquito breeding in school compounds and the children's activities at their own dwellings.

At present the school approach to source reduction has been implemented in five subdistricts of five different provinces, each with 30–50 schools.

Source reduction by community efforts

A pilot demonstration project on community participation for source reduction was initiated in 1984 in Banyumanik, Semarang (Central Java), covering 4,343 premises and a population of 21,660. A series of health education meetings were held at the levels of municipality, subdistrict, village, RK and RT. Source reduction campaign was organised by the subdistrict chief, supported by Kelurahan* chiefs, chief of RK† and chief of RT‡, social organizations, community leaders, health officers, etc. Technical aspects of the campaign have been periodically supported by the Health Centre as well as Municipality which also provided various health education materials. Here, the weekly community activities expected are; (i) removal of non-essential water receptacles, (ii) tight covering of water jars, and (iii) washing of larval breeding containers. The 4-weekly activities monitored by Health Centre of larval inspection in 60 premises showed that the Breteau Index in September 1985 was 15 as compared to 60 at the same period of 1984 (Sudarjo, personal communication).

During the period of 1981–1983, source reduction announcement was issued by the local government of Pekalongan, Karawang (Java) and Jambi, Kotabumi (Sumatra), followed by public education through different avenues[10]. In Pekalongan, this announcement was followed by a source reduction campaign through community volunteers in August 1985. At the beginning of the campaign larval survey was carried out by Health Centres and the Municipality Health Office. Result of the survey was brought to a public health education meeting at the Kelurahan offices, attended by the Kelurahan chief, chief of RK and RT, representatives of local Women's Club (PKK) and community leaders. It was decided to carry out source reduction by the community with guidance from volunteers. The volunteers were then recruited. Most of them were members of the local Women's Club (PKK). They were trained for two days, on simple health education and larval

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*Kelurahan is subdivision of Subdistrict consisting of 3,000–5,000 families.

†RK is subdivision of Kelurahan, consisting of 300 families.
Chief of RK is a volunteer, elected by the local community.

‡RT is subdivision of RK, consisting of 30 families. Chief of RT is also a volunteer, elected by these families.

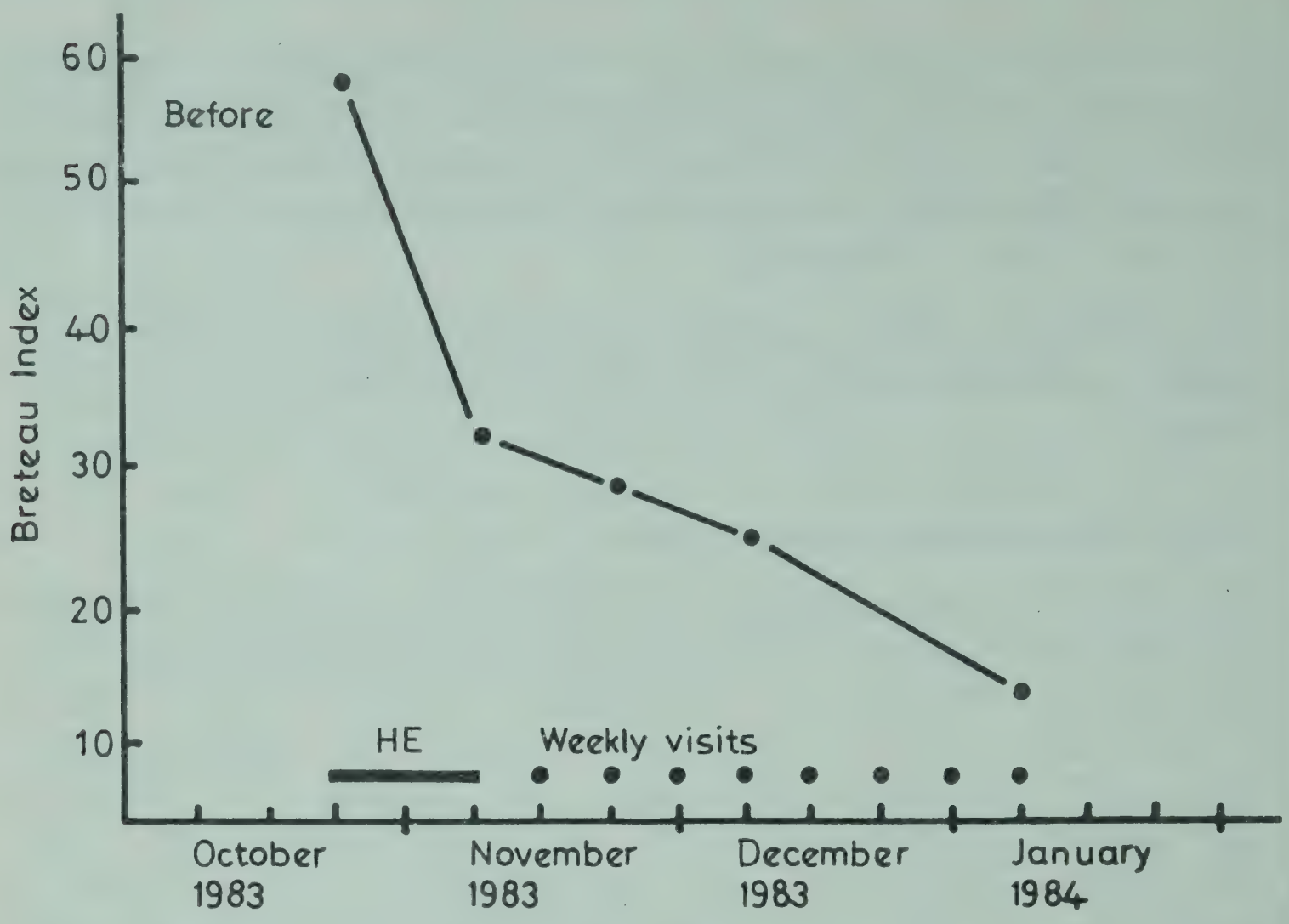

Fig. 4: Breteau index determined before and after source reduction campaign in Perumnas Banyumanik, Semarang Municipality, Central Java, Indonesia.

inspection techniques by Health Centre's. Each volunteer is responsible for 150 premises.

They were requested to make house-to-house visits once a month. The main tasks of the volunteers were; (i) to educate householders on DHF, particularly in source reduction, and (ii) to inspect water receptacles with potential of *Aedes* breeding.

Larval survey carried out by Municipality and Health Centres showed 57% reduction of Breteau Index and 52% of Container Index, six months after the initiation of the campaign (Table 6).

Table 6: ***Aedes*** **indices determined before and after source reduction campaign in Pekalongan, 1985**

Months	No. of premises examined	No. of containers examined	No. of containers with larvae	CI†	BI‡
July 1985	200	500	91	18.2	45.0
Dec. 1985	200	472	41	8.7	19.2

†Container Index.
‡Breteau Index.

Guidance to the volunteers by Health Centre's staff was continuously imparted through regular meetings, usually at the Kelurahan office.

On the basis of this experience, general guidelines for source reduction through community participation (along with a manual on training of community volunteers as well as a manual for the volunteers) were prepared in 1985 by the technical staff of VBC/CDC in collaboration with other units of the Ministry of Health and Ministry of Interior. It was recommended that a campaign for source reduction by the community is to be carried out by local community volunteers under regular and continuous guidance from the Health Centres.

Public places approach

In addition to the above community approach, source reduction campaign in public places was initiated in Pekalongan. The campaign aims at reduction of possible spread of dengue transmission from these places. Preliminary survey was carried out in 473 public facilities in August 1985 and a Breteau Index of 25.4 was obtained. Instruction by the mayor on source reduction in elimination of *Aedes* breeding places was announced and general guidance on source reduction was provided by the Municipal Health Office to the responsible persons of each public facility. Subsequent larval survey in these places is being undertaken.

Intensified source reduction by community as guided by temporary workers

As transmission and eventually case incidence declined following a series of mass larvicidings in highly endemic areas, it is necessary that the vector density should be kept as low as possible by the community itself.

Considering that such an area is still potential for recurrence of DHF outbreak, an intensified source reduction campaign was implemented since July 1985 by trained temporary workers recruited from the local community. Each temporary worker is responsible for 500 premises, to be visited door-to-door (20 premises per day) every three months, for health education and the inspection of *Aedes* breeding sites, under the guidance and supervision of the Health Centre staff. Water containers with potential for *Aedes aegypti* breeding are to be eliminated by emptying, burying or by other means carried out by the householders assisted by temporary workers. If action cannot be taken during the visit, 1% temephos SG at a dosage of 1 ppm is applied. Result of the larval inspection is to be recorded by temporary workers on a "larval card" provided to each house.

The card is kept by the householders, so that they can evaluate their own efforts in elimination of *Aedes* breeding sites. In 1985, this intensified campaign was undertaken in 13 Provinces, covering nearly 1,70,000 premises.

As a preliminary result from Wonosari subdistrict of Yogyakarta, three months after initiation of the campaign, 56% reduction of the larval indices from the pre-campaign level was obtained and the amount of temephos sand granules was reduced considerably (Table 7).

It is believed that with "continuous education and guidance" from temporary workers supervised by Health Centres, community awareness and

Table 7: Larval indices before and after each house-to-house visits by temporary workers in two villages, Wonosari subdistrict, Yogyakarta province

Month	No. of houses	No. of containers examined	No. of containers with larvae	No. of containers per house	CI†	BI‡	Amount of temephos used in kg
Aug. 1985	2,807	9,668	1,277	3.44	13.3	45.5	16.1
Nov. 1985	2,907	9,834	584	3.38	5.9	20.1	9.8

†Container Index.
‡Breteau Index.

involvement in DHF prevention will gradually increase. It is planned that when the larval indices are brought down to a low level (Breteau Index is 5 or less), this source reduction campaign will be handed over to the local social organization such as Women's Club (PKK) under guidance from the Health Centres.

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Role of Village Volunteers in control of Mosquito-borne diseases— Social and Economic Costs

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INTRODUCTION

Village volunteers are emerging as an effective tool in Primary Health Care strategies. In Thailand two types of volunteers provide health care from within the village community; Village Health Volunteers (VHV) and Village Malaria Volunteers (VMV). This paper is only concerned with the activities of the Village Malaria Volunteers as part of the Malaria Division's surveillance activities.

MALARIA SURVEILLANCE

At the time of the research, surveillance and monitoring, the antiparasite strategy of malaria control was concerned with a number of activities; (i) the collection and early examination of blood smears from patients with a recent history of fever or suspected of having malaria, (ii) presumptive treatment, where diagnosis can not be provided immediately to give, in principle, clinical relief from symptoms and render the patient non-infective to anophelines, (iii) radical treatment or referral to hospital of difficult cases and (iv) epidemiological investigation of cases to determine the type and origin of infection, follow-up of case to ensure that infection is cleared, and occasionally, mass

drug sureveys and/or drug administration to eliminate or prevent transmission. Changes in control strategy will include the cessation of presumptive treatment and dispensing of radical treatment to patients suspected of having malaria.

Surveillance services

This long list of activities is undertaken by a variety of services organised and managed in Thailand by the Malaria Division of the Ministry of Public Health. Services are provided through a system of Regions (5), Zones (8–10) within each Region and Sectors (10) within each Zone.

The major services engaged in the collection of blood smears are subdivided into Active Case Detection (ACD), where regular visits are made to every house in designated areas; Passive Case Detection (PCD), in which patients present themselves to service centres; and Special Case Detection (SCD), where the sector/zone office provides special outreach services to problem areas. Centres managed by the Malaria Division which contribute to PCD are: Malaria Clinics [Static (MC) and Mobile (MMC)] and Village Malaria Volunteers (VMV). Centres contributing to PCD, directly administered by the Ministry of Public Health, are Village Health Centres (VHC) and District and Provincial Hospitals (HP).

The proportion of blood slides and positive cases detected through each service depends upon demographic and geographic factors and the relationship between particular service centres and the population.

Village Malaria Volunteers

Village Malaria Volunteers are selected by the relevant sector chief after informally gathering advice about suitable candidates from people in the area. Criteria for selection are the ability to read and write (normal in Thailand) and being well-known and respected in the village.

If an area is in the Control Phase (high incidence) one or two VMV may be appointed to each village depending upon the geography of the village and population. In the Consolidation and Partial Integration Phase the number of VMVs depends on incidence. Normally a VMV will only be required where migration brings cases into an area of low incidence. The total number of VMVs in 1983 was 35,115 in 29747 villages[1].

Until recently volunteers received two days training at the sector office prior to appointment. Now that USAID has ceased each sector is responsible for providing the most economic training using a standard training package. Training includes knowledge of symptoms associated with malaria, the role of the volunteer and development of competence in taking blood slides. Formal appointment and issue of a certificate is made by the Malaria Division after satisfactory completion of training.

Volunteers have four functions; (i) taking blood slides and providing presumptive treatment (the latter is now being replaced with radical treatment since small drug doses increase resistance), (ii) communicating between the Ministry of Public Health and villagers (health education), (iii) providing information for the Ministry about the health of villagers and (iv) co-ordinating spraying in the village.

Efforts are made to collect slides from VMVs at least every seven days to ensure rapid diagnosis and treatment. In very remote areas, where collection can not be made every seven days volunteers use local transport services to send slides for microscopic examination. Radical treatment is then provided by the sector office.

The general picture of the VMVs is a committed band of volunteers dedicated to providing a service for their community. In practice only about 70% of volunteers are found to be active. However, demand on the services of VMV is not simply a product of the availability and attitudes of the volunteers. A higher demand for complementary service, such as Malaria Clinics, can arise because the service provides immediate diagnosis and treatment.

ECONOMIC AND SOCIAL COSTS

The costs of providing surveillance can be considered at three levels; (i) internal costs, costs incurred by the institution providing services (in this case the Malaria Division), (ii) external costs, costs incurred by patients (expenditure on drugs, travel to a treatment centre and time costs due to debility), these costs are external to the Malaria Division and (iii) total costs, the sum of internal and external costs.

A survey of surveillance activities in two zones in Malaria Region 1 yielded useful insights as to the magnitude of internal costs (Tables 1 and 2) and the factors contributing to these costs.

Differences in the cost per blood slide (cost/patient) for each service are largely associated with differences in the cost of collecting slides since costs for examining a slide, for material and for presumtive treatment are essentially the same for every service. The ACD and VMV scheme also have a high administration cost because considerable time is required for the supervision of field personnel.

In terms of costs per positive case ACD, VMV and VHC all show significantly higher costs than Malaria Clinics. High costs of ACD are largely dependent upon a low slide positive rate (SPR). The high cost for VMV and VHC are tied to the time and transport costs incurred in visiting each positive case to provide radical treatment and monitoring. These data raise several questions which are considered under the section on implications.

Table 1: Cost per blood slide examined

Services		Zone A		Zone B	
		Relative contribution* (%)	Cost/ blood slide (Baht)	Relative contribution* (%)	Cost/ blood slide (Baht)
Malaria Clinics	(MC)	71	37	52	26
Village Malaria Volunteers	(VMV)	15	44	17	47
Village Health Centres	(VHC)	5	26	4	18
Active Case Detection	(ACD)	5	37	17	14
Hospitals	(H)	2	NA	3	NA
Other services		2	NA	7	NA

Table 2: Cost per case detected

Services		Zone A		Zone B	
		Relative contribution* (%)	Cost/ case (Baht)	Relative contribution* (%)	Cost/ case (Baht)
Malaria Clinics	(MC)	57	150	56	100
Village Malaria Volunteers	(VMV)	7	1,600	14	500
Village Health Centres	(VHC)	3	1,000	5	200
Active Case Detection	(ACD)	2	5,400	16	450
Hospitals	(H)	30	NA	4	NA
Other services		1	NA	5	NA

$$\text{*Relative contribution (\%)} = \frac{\text{number of cases detected/treated by a service}}{\text{total cases detected/treated by all services}} \times 100$$

NA = Not available.

The relative magnitude of the internal cost for each type of service and the factors contributing to these costs are clearly important when trying to improve efficiency in the use of the resources available to the Ministry of Public Health. But external cost (costs to patients) must also be considered if one is to look at the total cost to a community and make efforts to improve efficiency in the use of resources within a community.

Costs incurred by patients are time lost when the patient is absent from work prior to seeking care, costs of self-prescribed drugs, costs of travel to a service which will take a blood smear, time lost when travelling, time lost while awaiting diagnosis and treatment (a matter of hours for a Malaria Clinic but 7-15 days for VHV) and, if incapacitated, time off from work until cured. Costs for patients attending Malaria Clinics are presented in Fig. 1.

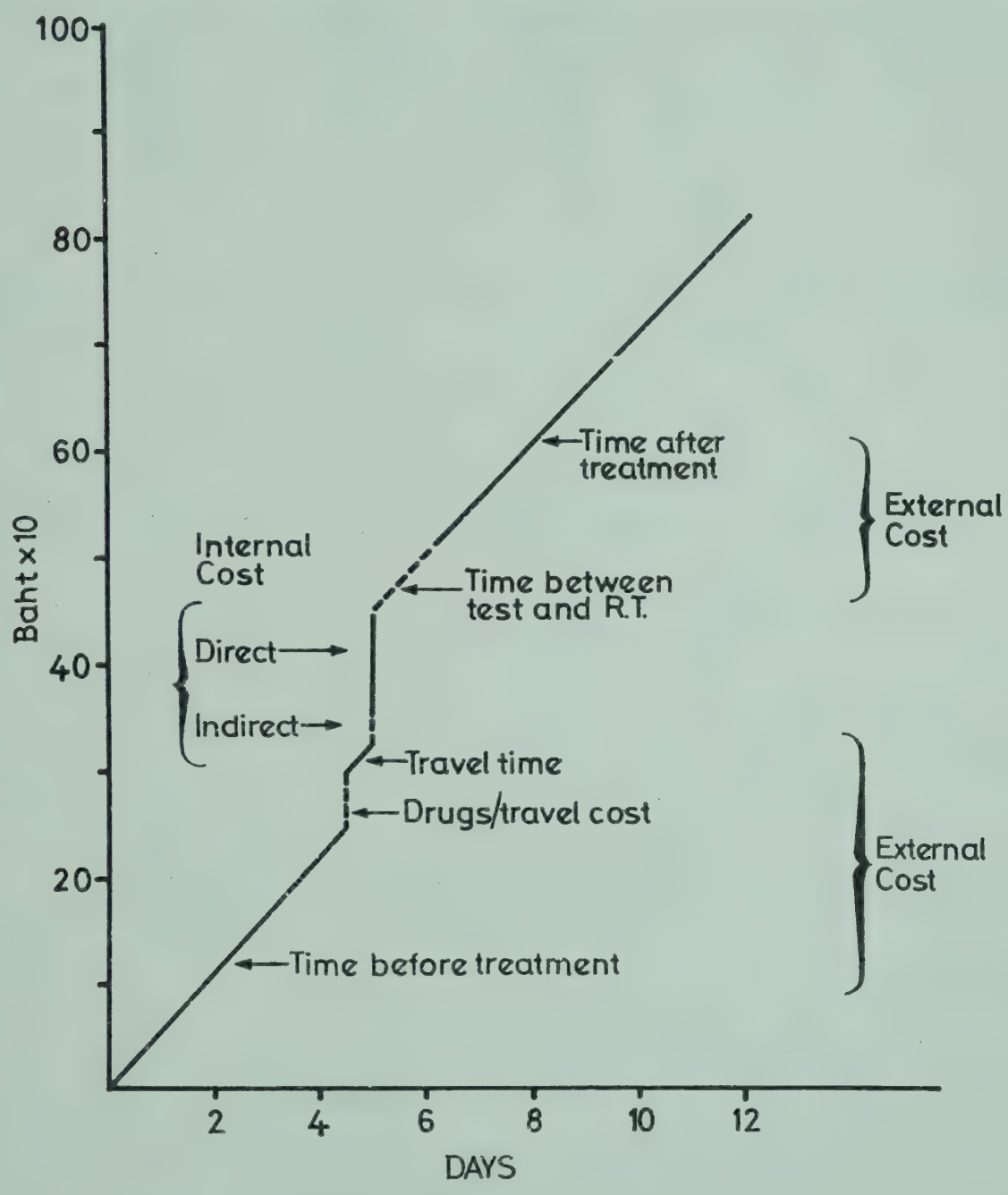

Fig. 1: Costs and performance of malaria surveillance.

IMPLICATIONS

The interplay between internal costs, external costs and performance for Malaria Clinics presented in Fig. 1 raise important issues when applied to VMV.

—Patient performance in seeking care is a major factor in total cost. The ready availability of a VMV should improve patient performance in seeking care.

—The presence of a VMV eliminates travel cost for patients and markedly reduces travel time cost when attending a service point.

—The efficiency of collection, diagnosis and treatment will affect costs to a patient. For a Malaria Clinic this time may be one day. For a Village Malaria Volunteer this could be 5–15 days (Table 3).

Table 3: Time between taking a blood slide and providing Radical Treatment

Services		Zone A		Zone B	
		Relative contribution* (%)	Average time (days)	Relative contribution* (%)	Average time (days)
Malaria Clinics	(MC)	71	1.3	52	1.2
Village Malaria Volunteers	(VMV)	15	11.1	17	7.8
Village Health Centres	(VHC)	5	13.8	4	8.4
Active Case Detection	(ACD)	5	15.9	17	8.1
Hospitals	(H)	2	8.8	3	5.9
Other services		2	NA	7	NA

*Relative contribution (%) = $\frac{\text{number of cases detected/treated by a service}}{\text{total cases detected/treated by all services}} \times 100$

NA = Not available.

—The system of slide collection from VMV affects internal cost (cost to the supplier) and external cost (costs to patients). Optimisation of routing in the collection of slides and in the number of blood slide collectors is essential if these costs are to be minimized.

—The high internal costs of VMV, (cost/blood slide and cost/positive case) can not be used as the only criteria for deciding on the level of services to be provided. Surveillance services are complementary, not alternatives, and the basis of patient performance towards specific services is not yet fully understood.

Research to analyse the relationship between internal cost, external cost and patients performance for the major surveillance services is currently being undertaken in Thailand[2]. It is hoped that the results may allow more informed decisions to be made in the allocation of budgets (internal cost as a proportion of total cost to the community), in deciding on the level of services best suited to meet patients needs at lowest cost, and in deciding how best to organize VMV services.

Other countries which have developed similar services also report benefits and some difficulties with VMV type services. But many of the difficulties can be solved given analysis of cause and corrective action. For example in Guatemala[3] where VMV services account for 73% of blood slides, the voluntary service has a significantly higher SPR than other services.

But a recent survey revealed two disturbing features. Firstly the average time between taking a blood slide and providing radical treatment was 30 days with a maximum of three months. This delay is damaging to patients and increases the probability of further transmission.

Secondly many patients who should have attended a VHV service point failed to do so. In a sample of 100 positive cases, 24% who visited a VMV service point, 59% were self treated and 13% sought no treatment. Major reasons given for not visiting a post were that the volunteer was usually absent, the chloroquine tablets caused undesirable side effects, the finger prick was unpleasant and injections were preferred to oral medication.

An increase in treatment rate of 50% by VMV was achieved in Guatemala on reducing the time between taking a blood slide and providing radical treatment to 17 days, selecting families to act as a VMV centre so that a person is normally available and giving evaluators (persons who collect slides and supervise VMV personnel) a more active role in community health.

Village Malaria Volunteers have and will continue to make an imprtant contribution to malaria control strategies. But if their effectiveness is to be improved more study is required of the factors affecting their performance and informed decisions made as to the best system of operation.

ACKNOWLEDGEMENTS

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Some Recent Efforts to Mobilize Community Participation in Anti-Malaria Activities in Sri Lanka

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INTRODUCTION

As in other countries in the region, the anti-malaria activities in Sri Lanka have long been associated with centrally administered intervention programme. From its inception in the 1930s, the Anti-Malaria Campaign (AMC) of Sri Lanka carried out its various antiparasite and antivector operations and approached the relevant human population groups for this purpose through a bureaucratically organized hierarchy of malaria workers whose *modus operandi* and functions were largely technocratic in character. With its conversion into an eradication programme in the 1950s, the technocratic features of the AMC became even more prominent. While the relevant human issues and the socio-economic and cultural factors were by and large ignored, the public was expected to cooperate with the AMC merely as passive recipients of its services.

More recently, however, there has been considerable rethinking about the question of malaria control in Sri Lanka. The need for increased community participation in anti-malaria activities has become evident due to several factors. Firstly it has become necessary for the AMC to change its strategies in view of the increased emphasis on PHC throughout the country's health care system[1]. The new interest in community participation has also emerged as a response to numerous problems encountered by the conventional approach to malaria eradication. The AMC has not been able to avert a full scale resurgence of malaria in the country since 1967, despite the rapid reintroduction of its regular anti-malaria operations throughout the affected areas. High refusal rates affecting spray coverage (according to recent statistics refusal rates are as high as 30 to 40 per cent) and poor compliance for chemotherapy have necessitated the AMC to make positive efforts for gaining

public cooperation. Due to increased limitation of funds and manpower resources available for large-scale administration of chemical methods of malaria control[3] as well as due to its possible harmful effects on environment, it has become necessary to look for alternative methods of malaria control implemented through enhanced participation of the community.

This paper examines two recent efforts to enlist community participation in anti-malaria activities in Sri Lanka, focussing on their impact on vector control. The first is an effort by the AMC itself to involve health volunteers in its activities at the grass-root level. The second is a pilot project started by a well-known non-government organization in Sri Lanka, namely the Sarvodaya Movement, for establishing community-based vector source reduction activities as a method of malaria control within a limited geographical area in Sri Lanka. Let us briefly consider the experience and the results of these projects.

ROLE OF HEALTH VOLUNTEERS IN AMC ACTIVITIES

In Sri Lanka, the systematic efforts to establish a cadre of health volunteers at the village level began in the early 1970s as a by-product of the Pilot Community Health Projects undertaken by the Health Education Unit under the Ministry of Health[4,5]. Subsequently, the importance of health volunteers (HVs) in community health activities became clearly established during the early phase of the Mahaweli Settlement programme which began in 1977[6,7]. In a situation where the existing health care facilities were grossly inadequate to meet the health needs of many thousands of new settlers, the significance of HVs was appreciated by both the health service providers and the local communities. Although there were earlier experiments where HVs were involved in anti-malaria work, the AMC openly recognized their role and began to work with them on a long term basis in newly established Mahaweli Settlements where malaria had become a major health problem.

The Health Education Bureau (HEB) of Sri Lanka, with its long experience in work with HVs, collaborated with the AMC and the Mahaweli Authority in promoting the role of HVs in anti-malaria work in new settlements under the Mahaweli programme. The local public health staff consisting of Public Health Inspectors (PHIs) and Family Health Workers (FHWs) selected volunteers from each locality in consultation with both local community leaders ('tract' leaders) and local representatives of the Mahaweli bureaucracy (mainly Unit Managers). As reported by Patrick[5], the newly selected HVs were mostly in the 15 to 25 age group. Among them girls outnumbered boys in a ratio of 2:1. Most of them were out of school youths who had received formal education at least upto the 9th grade. Each volunteer was expected to serve his or her own neighbourhood consisting of roughly about 25 households.

Once selected, the training of volunteers was done in two phases. In the first phase, the volunteers were given a general PHC training with a focus on

preventive and curative skills needed by their own communities[5,7] .For this purpose the HEB developed a standard training module whereby preparatory training was given in training sessions covering a total of 60 hours conducted over a two month period. The training programme consisted of lectures (15 hours), field visits and clinic sessions (35 hours) and socialization techniques (10 hours). Initially many of the lecture sessions were done by health educators under the HEB, while field visits and clinic sessions were guided and supervised by the local public health staff.

In the second phase a specialized malarial training of one week's duration was given to the volunteers by the local AMC staff. The objective of this training was to introduce basic facts about malaria transmission and control and to impart basic skills for symptomatic treatment of fever, administering the five day course of treatment and taking of blood films from local fever patients[5,7] .Both PHC and malarial training were given in local community settings, causing least interference with the HVs' day-to-day life in the community. During malaria epidemics the order of training was sometimes altered and the newly selected HVs were first given malarial training in order to mobilize them quickly for anti-malarial work.

Following their specialised malarial training, the AMC expected the HVs to contribute to its curative, surveillance and vector control activities. They were supplied with anti-malarial drugs and blood films in order to enable them to serve the community as a curative agent and at the same time help the AMC in its surveillance operations. More importantly, their assistance was sought in enhancing the spray coverage of the AMC. Their tasks included helping the spray teams to secure accommodation, storage facilities and water and assisting householders to both prepare their houses for spraying and to rearrange their houses as needed once the spraying was completed. They were to facilitate accessibility to houses where the occupants were unavailable or unwilling to cooperate with an outside spray team. Finally, the HVs were expected to educate the fellow community members about why spraying is necessary and thereby eliminate any of their existing misconceptions about its effects. On the whole they were seen as coordinators between the PHC staff and the local peasants.

Presently, there is no sufficient data for us to be able to fully evaluate the performance of HVs in malaria control activities. As of now the active participation of HVs in anti-malaria work is by and large restricted to certain areas under the Mahaweli development schemes where conditions are generally favourable for community based health activities. Further it appears that both the AMC and the public tend to lose their interest in the HVs once a malaria epidemic is over. There is, however, clearcut evidence that the HVs play a critical role in enhancing the spray coverage of the AMC. The data in Table 1 reported by Patrick[5] sums up the HVs positive contribution to the AMC activities.

Table 1: Spray Coverage with and without HVs

MOH Area	Refusal Rates			% of Houses completely sprayed		
	1975	1976	%	1975	1976	%
	No HVs	HVs introduced	Reduction	No HVs	HVs introduced	Improvement
Anuradhapura	19.1	11.4	7.7	59.4	64.8	5.4
Puttalam	26.4	10.6	15.8	34.1	66.2	32.1

It is interesting to note that the improvement in spray coverage resulting from the introduction of HVs is much greater in the Puttalam MOH area where there is a concentration of Muslims, a minority ethnic group in the country.

An important sociological consideration with regard to the role of HVs in anti-malaria work relates to the fact that while the lower-level field staff of the AMC consists exclusively of males, females are predominant among the HVs. While this means that through the female HVs the AMC is now able to gain access to female occupied households, to the extent that there is a customary segregation of males and females in public activities and social life, it can affect the relationship between male malaria workers and female volunteers and, indirectly the acceptance of both by the community. This highlights the need for considering complex socio-cultural issues in designing community-based health programmes.

SARVODAYA APPROACH TO VECTOR CONTROL

As a prominent non-governmental organization, Sarvodaya has functioned in Sri Lanka for over 25 years now. Influenced by Gandhian principles of non-violence and self-reliance it seeks to promote economic development and social harmony of village communities accompanied by a corresponding emphasis on moral rehabilitation of the people. Nationally led by a charismatic leader with dynamic qualities, the Sarvodaya Movement has a considerable social base even in remote dry zone villages where malaria is endemic. Hence its interest in developing a malaria control strategy which is both philosophically in agreement with Sarvodaya principles and effective in reducing the malaria burden of the peasants.

Sarvodaya advocates a PHC approach to malaria control and argues that the large-scale use of chemical methods of malaria control is not in the best interests of Sri Lanka.

> "Sarvodaya is convinced that long term control of malaria in Sri Lanka, primarily by synthetic insecticides and anti-malaria drugs is neither feasible nor desirable"[8].

Its arguments against eradication measures include their high cost, adverse effect on environment, tendency to enhance vector resistance to insecticides and parasite resistance to antimalarial drugs and their negative effects on the immunity levels among the people. Implicit in its critique of the eradication strategy is also the fact that the widespread use of insecticides to kill mosquitoes is morally unacceptable to the Sarvodaya Movement in view of its commitment to non-violence and compassion.

In the early 1980s, Sarvodaya began a pilot project in the Anuradhapura district in order to devise ways and means of promoting village level self-reliance on the anti-malaria front[8,9]. The funding support for this project came from OXFAM, the Ford and Charles Stewart Mott Foundations and WHO. This project tried to identify methods of malaria control that are "effective, renewable, inexpensive, safe and manageable by the village communities with least technical guidance by the experts"[8]. The principal aim of the project was to encourage and assist local communities to practice methods of source reduction, using locally available and renewable resources[9]. Such methods include filling and draining of actual and potential vector breeding sites through the mobilization of *Shram Dan* labour, introduction of larvivorous fish to local streams, use of cattle and goats to divert vectors away from human targets and depositing of decaying organic plant matter and manure in stream beds and water seepage sites so as to create conditions deterimental to the development of *A. culicifacies* larvae. Limited use of monoxci is made where other methods of source reduction are not applicable. Identification of local vector breeding sites, application of the above mentioned source reduction methods for control of vector breeding sites so identified, taking of blood smears for the purpose of malaria surveillance, follow-up of fever cases in the community and delivery of anti-malarial drugs to those with symptoms of malaria are done by Sarvodaya volunteers at various levels, assisted by Childrens' Group (Lama Havula), Youth Group (Yovun Havula), Mothers' Group (Mav Havula) and other community organizations which are part of the normal Sarvodaya organizational structure in any village.

The results of these experiments in community-based vector control operations are not yet known. They provide interesting examples of the kind of community operations in malaria control that may complement the nation-wide programme of the AMC. However, uncritical acceptance of certain ideological positions may prove to be counter-productive in the effort to evolve a suitable combination of strategies that may produce the best results.

CONCLUSION

The recent efforts to mobilize community participation in malaria control in Sri Lanka have stemmed from both government and non-government initiatives. The results of these efforts are only partially known at this stage. To the extent their results are available, they reveal that the HVs,

community organizations and relatively simple vector control strategies implemented at the village level can make an important contribution within a nationwide malaria control programme.

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Community Participation facilitated by Socio-cultural Communication

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INTRODUCTION

Rene Sand's dictum "health can't be given to the people, it demands their active participation"[1] is a burning problem today and public health workers all over the world are often faced with the problem of why people who need a particular service, are least likely to use it or fail to secure the total benefit which is expected. A case in point is immunization which has not gained universal acceptance by the people so far.

Malaria eradication and family planning programmes in the developing countries, particularly in India, are recent examples of health services of which the people are not making use to the extent desired. Similarly, programmes relating to mother and child health, immunization and nutrition, have all proved abortive or partially successful. The resistance of the people is felt not only in the field of public health but also in endeavours designed to improve the standard of living of the people. The central question in public health has become, why do people behave as they do? This is the basic problem which public health workers are facing nowadays.

"Western style" public health workers are gradually replacing "traditional healers" in many communities but without being an integral part of the community as the healers were. The new type of service remains inaccessible or unacceptable and is not in keeping with the cultural and traditional values and general life style of the community. Hence, many well-intentioned and technically sound programmes aimed at resolving major health problems have been frustrated by a lack of popular acceptance and community participation. It has often been pointed out that such programmes are actively rejected or passively ignored because they do not belong to the people. Thus, these are

considered externally imposed programmes that belong to the Government and consequently deserve and require little or no response.

One of the major objectives of public health is to increase the number of individuals who take part in vector control and mass screening programmes such as T.B., cancer and diabetes detection, and immunization. These are actions the individual must decide to take for his own good, and the extent of voluntary cooperation is the key to a successful public health programme. Although the public stands to gain most from the success of health programmes, its willingness to participate has always been disappointing in spite of well organised attempts to arouse public interest and to make participation easy.

Most voluntary public health programmes are noted more for their failure than for their success. Very rarely do such programmes achieve the goal set for them by optimistic public health workers. This is partly the result of unrealistic expectations of the degree to which the public may be counted upon to cooperate voluntarily without any official request.

This is illustrated by my personal experience during filaria control operations in Kerala state in South India, where I attended a course in filariology. In the field practice areas, all students are to carry out mosquito reconnaissance, vector control duties, mass blood sampling, examination and treatment of positive cases.

Wuchereria bancrofti and *Brugia malayi* filariasis are prevalent in that region and both have nocturnal periodicity. That is why blood sampling is done at night. When I made house to house visits in Calicut city I found the people averse to the idea of blood collection, examination and treatment.

In an attempt to overcome the hostility of the people, I decided to adopt the local language, dress and folk culture.

Subsequently, one evening I went to a local temple and greeted the priest in his native language and also talked about Kerala's temple dances. The priest was pleasantly surprised to observe a northerner talking in Malayalam and showing interest in the local culture. I introduced myself to the priest and explained my problem to him. The priest at once volunteered to give his blood and I took a sample before a large gathering. This worked like a miracle and the people's resistance melted quickly. The local people had full faith in the priest and on his advice everybody submitted to blood examination and treatment. In about an hour or so I collected and examined 96 blood samples and gave radical treatment to 12 positive cases on the spot. Later, while dealing with people in vector control in different localities, I adopted the same technique with positive results[2,3] .

The method of obtaining a cross cultural outlook in medicine is described in detail by Maurice King[4] who emphasises:

—Observe the community closely. Use what is visible to lead to what is invisible in terms of attitude, values and goals etc.
—Read some anthropology. See if there have been any specific studies of the tribes in the area and read them.
—Make the acquaintance of any anthropologist working in the vicinity, obtain an insight into the local culture by carefully questioning some of the more educated members of the community.
—Take at least some steps to learn the local language even if it is only the greeting and necessary clinical questions and imperatives.

John Bennet[5] stresses the need of meeting religious leaders such as priests who reach adult audiences directly where they are in a good position of influence. They are highly motivated and they visit patient's homes. If a priest recognises Kwashiorkor and knows something about food values, he can be a successful health visitor.

PILOT STUDIES

In an experimental study in Nigeria[6] on health behaviour an attempt was made to identify factors associated with acceptance or rejection of recommended preventive measures and their continued application in the communities. It was found that social interaction by way of involving the community produced better results than the individual approach through the mass media system.

In another integrated health care experiment in an Amazonian community in **Brazil**[7], several approaches were tried to motivate the community during sex education courses. It was found that with community participation, cultural conflicts and difficulties were resolved.

In Columbia Rice-O-Sierra *et al.*[8], carried out a survey in an attempt to promote community participation in local health services. Deficiencies detected in the functioning promoted the suggestion that community participation should be encouraged for the successful functioning of health services.

A study of some Latin American experiences[9] of community participation in the health services permit consideration of the following as the minimum requirement for establishment of inter-relationship between local health agencies and the community: a respect for the community in contact with the health organisation. Finally it was stressed that active and organised community participation in health activities is the best guarantee for successful implementation of health programmes.

Community participation in the integrated health services at Miraj (India)[10] with the aim of making it a people's project is another example. As the project moved community participation deepened. The community provided a

building for the sub-centre and arranged mass immunization and sanitary campaigns periodically. Now the community looks upon the project as their own and takes pride in it.

In India various agencies involved in the study of safe water failed as the community was not involved in planning and maintaining the water supply system. In an experiment[11], a local waterworks committee was set up with powers to appoint staff and make byelaws. The result was that the people accepted the programme whole-heartedly and the number of water connections increased steadily.

In Java though the performance of a community health centre was satisfactory, Dr. Yahya, the then Medical Officer felt that genuine community participation was still lacking. In summing up his feelings, he stated, "the community participates only when we ask it to. This type of community participation has no firm roots in the community and will last only as long as we are there to maintain it."

Dr. Yahya[12] felt that the result of building true community based health care, was not just community participation in the health services rather the people should be able to take over the initiative and basic responsibilities. In short, what was needed was "Health care by the people". It is on this concept that this programme is now based.

In South-Central Cameroon, community participation to improve sanitary and other health conditions was successfully activated by means of village health committees.[13] The accomplishment of various programmes like latrine construction, water supply source protection and similar projects were gratifying in themselves, but it was heartening to note the catalytic effect that community organisation seemed to have on other aspects of rural life. The village health committees serve as a springboard for rural development.

Another example of community participation is found among the people in a group of villages in Surinam[14]. They laid down pipes for a new water-supply system and assumed responsibility for improvement of their health. Through active community participation clean drinking water is now available in every home.

The recent plan of the Government of India, takes into consideration human and social factors in planning, development and operation of the world's largest public health programmes against malaria. Realising the importance and magnitude of the problem, the Government of India has begun to adopt a revised strategy to contain malaria through the active participation of the community by constituting committees of village leaders in tackling the rising malaria incidence in the community [15].

The American Journal of Public Health in its editorial has stated[16], "Health workers agree, generally, that now is a period when human factors must be taken into account if public health is to handle its problems successfully. Many

of the areas of health with which public health is today concerned involve individual voluntary action on the part of many people".

DISCUSSION

To come back to the central question of public health, why do people behave as they do, there can be little question that the successful conduct of many public health programmes today requires individual and community support. The people must be induced to participate in malaria and filaria vector control, immunization, family welfare programmes and health education drives with a view to change drinking, smoking and eating habits, if these programmes are to be made successful.

Effective community participation is essential in achieving the aims of the programme for development of health services. A community's traditions, cultural patterns, expectations and experiences are often key factors in securing its participation. This in turn is valuable in creating community awareness of the importance of services provided and enhances the people's ability to contribute to the improvement of local conditions.

RECOMMENDATIONS

The basic philosophy of a community based health programme should be translated into the following programme strategy.

—Know the community and let the community know you. One fact often overlooked is that public health workers are cultural strangers to the community. For them to function effectively the cultural gulf must be bridged.

—The public health workers responsible for the conduct of a programme should acquire some knowledge of sociology in dealing with the community.

—The plan of public health programmes should consider the concept of community participation and responsibilities to take a concrete form by the constitution of Health Committees.

—Respect the values of the community.

—Utilise the mechanism of community participation to discover and understand the priority needs, constraints and potentials within the community.

—Specific objectives should be identified to facilitate the optimum implementation of Public Health Programmes.

—Community based (available and accessible)health services should be provided for greater health coverage and community involvements.

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Community Participation in Vector Control—Considerations based on Thai experience

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INTRODUCTION

Community participation in health development is easier said than done. Countries committed to the social goal of Health for All by the Year 2000 enthusiastically launched large-scale (regional or nation-wide) community based Primary Health Care programmes. Yet various Primary Health Care evaluation studies consistently found that the extent of community involvement in most government-induced PHC programmes was markedly inadequate, often falling far short of what the concept generally connotes. During recent years literature on community participation in rural development and Primary Health Care has been piling up rapidly. Ironically, this does not seem to have significant impact on the existing community participation practices in most government Primary Health Care. In Thailand too, studies have established that the kind of government-sponsored community participation in PHC activities at the village level is markedly passive and not sustainable. To date, there have been inadequate efforts to effect changes in community participation practice in the Government Primary Health Care system. Bureaucratic constraints and inertia are effectively weighing down the government's capability to cope with the complex tasks of promoting community participation which requires great flexibility and ingenuity in approach and operation.

As a latecomer to the participatory approach, the community-based model in vector control should not repeat the same failures (as far as community

participation is concerned) in the national Primary Health Care programmes. The main objective of this paper is thus to discuss briefly some salient points for promoting community participation in vector control, based primarily on the authors' research experience in community participation in the PHC programme in Thailand (Centre for Health Policy Studies, 1982), and also a baseline study on knowledge, perception and behaviour of malaria[1].

HEALTH EDUCATION—A TIME FOR ACTION

It shall be a great redundancy for this paper to elaborate the need for health education in promoting community participation in PHC and vector control. More than enough has already been said about it elsewhere. The great contradiction is, however, that most concerned authorities talk about it but extremely few seriously implement it.

After more than two decades of vertical malaria control programmes and the wonder of mosquito-killing insecticides, it is heartbreaking indeed to learn that the majority of people in endemic areas are not aware of breeding places and feeding times of anophelines. They neither know about the cause and spread of anophelines, nor do they know about the cause and spread of malaria, and the effect on mosquitoes of insecticidal house spray. Unless critical awareness of vectors and their relationship with diseases and people's livelihood is raised, people's active participation in vector control would never be forthcoming.

Under the single vertical top-down approach to vector control through the use of pesticides/insecticides, it can be fairly said that health education has been accorded low programme priority, and it is hardly practiced by field vector control workers[2]. Now with the change of emphasis of vector control to an integrated approach with community participation can we entertain the hope that health education will be seriously implemented?

A critical look at educational processes in the implementation of the Thai national Primary Health Care programme reveals more of a pessimistic outlook. At present the programme contains community based PHC activities relating to availability of medicines for common ailments (village drug cooperatives), nutrition (surveillance and supplementary food distribution), water and sanitation, family planning and MCH. Yet most of these activities are vertical in approach and involve only passive community participation. At the operational level the educational component in the implementation is almost non-existent. The peripheral health workers hardly provide education relating to the introduced activities and the health system, though emphasizing health education in theory, does not really enforce and motivate the peripheral health workers to do necessary health education work. Take the village drug cooperatives, for example. In setting up the cooperatives, the villagers are subject to governmental persuasions mainly in terms of expected share dividends and availability of household (common) drugs. This is so

despite the fact that in most villages there already exist one or two grocery stores where many kinds of medicines including antibiotics are on sale. Any serious student of the Thai health system must have been aware of the extremely free market systems of pharmaceutical products in Thailand which is not only economically wasteful but also, in many instances, harmful to health. The problem of inappropriate drug consumption is particularly acute among villagers. Yet the village drug cooperatives bear no relationship with this problem, no educational effort to raise critical awareness of inappropriate drug consumption is attempted. In practice, the villagers are left to self-treatment, resorting to whatever drugs, no matter how potent, under or overdose, out-of-date or not, which in their experience can effect the cure. Essentially the village drug cooperatives are just another additional source of drugs which can hardly compete with other drug grocery stores in the village.

It should be apparent that there are reasons for grave concern about serious and determined health education efforts in community based vector control. A long history of lip service, has created a tendency among the people to ignore serious attempts at participation. Political commitment and critical awareness of the programme managers are necessary for a strong and continuous educational process in any community based vector control project.

BROADENING THE SCOPE OF PARTICIPATION

Implementation of PHC in most countries has relied heavily on deployment of community health workers. At the same time the community health workers are regarded as manifestations of community involvement. In the context of Thai PHC nearly 50,000 village health volunteers and 5,00,000 village health communicators were trained for 5–7 days to serve in villages throughout the country. The national malaria control programme too has been deploying village malaria volunteers mainly in surveillance, active case detection and provision of presumptive treatment.

The use of community health workers is not always effective in eliciting sustained community involvement in PHC activities. In Thailand, village health volunteers tend to be regarded as "extended hand" of the government. In the majority of villages, it is the individual village health volunteer, not the community organizations or the community at large, who are performing the government-introduced PHC activities. Many of them are feeling more and more the burden of shouldering such voluntary work and the rising opportunity cost of participation over time. As a result their performance tends to be declining.

Reliance on the community health worker approach results in narrowing the breadth of community participation which is fundamental for sustained involvement. It leads to failure to enlist involvement of other potential key persons or leaders who are locally active and perhaps more effective in organizing communal efforts relevant to PHC activities. These potentially key

persons/leaders cannot be determined *a priori*. Only if relevant community structures, values and way of life are well understood, can the potential local key persons/leaders be identified. For example, in a number of villages, the village Buddhist monks are informally playing an active and effective role in mobilizing community efforts for PHC development. Our study of malaria in central Thailand revealed that in rural areas where malaria is endemic local doctors/clinics/drug stores have already been providing acceptable care for many illnesses including malaria. Obviously, any community-based malaria prophylaxis programmes which fail to foster involvement of these key local persons would not be optimally effective.

Granted that externalities prevail in benefit and cost of vector control activities and that the control activities heavily involve environmental management measures, the need for flexibility and ingenuity in locating relevant potential key persons/leaders to act as community change agents and thus broadening the scope of participation is of fundamental importance for sustained community-based vector control. Simply relying on an individual-oriented community health worker approach does not seem to be effective in fostering sustained community participation.

TREATMENT AND COMMUNITY PARTICIPATION IN VECTOR CONTROL

Community-based vector control programmes cannot do without treatment and/or prophylactic activities for the problematic vector-borne diseases. This is so because as revealed by our study of malaria, relief from suffering and recovery from illness are people's high priority felt need, and they have already been actively participating in treatment or prophylaxis through the practice of self-care and the use of accessible local lay doctors/pharmacists. A fully community-based vector control programme may even benefit from using community involvement in treatment as a lever for subsequent extension to vector control activities.

TEMPORAL ASPECTS OF COMMUNITY PARTICIPATION

It is often alleged that for effective contribution to vector control, community participation needs to be continuous and sustainable. To be realistic such requirements have to be tempered with the temporal dimension of life in the community. This is so because participation, particularly in the form of labour contribution, normally involves time which is a scarce resource for individuals, households and the community.

In a general way, the temporal dimension of participation can be represented by a continuum from single to continued participation action. It is likely that the opportunity cost of participation and hence the difficulty of

securing it usually increases as we move from single action programme to another requiring repeated actions. It must be mentioned, however, that the continued action type of participation may not necessarily mean a high opportunity cost if such action is integrated into the people's way of life.

The above-mentioned temporal aspect of participation should have significant implications for organizing community participation in vector control. Personal protective measures such as bed-nets, repellents, suitable clothing etc., can be regarded as continued participation. Obviously, it is not easy to organize the community for such continued action. To attain sustained participation in personal protection, the vector control programme has to emphasize effective health education and overcome socio-economic structures and relations which are conditioning the established problematic behaviour. This means among other things that socio-economic betterment has to be an integral part of community-based vector control programmes.

Enormous potential for community involvement in vector control lies in environmental management for source reduction and larval control[3]. It should be stressed that such periodic community actions would best benefit from the mass campaign approach which involves the whole community in a collective effort. The planning of such periodic community action should coincide with both the epidemiological cycle of the disease and seasonal tempo of economic activities of the community.

HEALTH SYSTEM SUPPORT—A MUST

We should be frank enough to admit that community participation in PHC in general and in vector control in particular is at best a sponsored participation, especially in the initial stages of the programme. For the sponsored participation to continue and become self-sustaining, prolonged logistic, technical and moral support from the health system or the vector control programme is a must. This raises grave concern about the capability and orientation of the front-line vector workers or health personnel in implementing the participatory approach. Of no less concern is the organizational and managerial capability of the vector control programme itself in supporting community-based activities.

The basis for our concern stems from the established fact that in implementing community-based PHC activities under the national programme in this country, the government peripheral health workers and the health systems prove to be incapable of providing adequate and continuous logistic/technical/moral support to the communities. In effect, soon after the government introduced PHC activities were set up, the communities were left alone to continue by themselves, as a result community enthusiasm for the imposed activities quickly faded.

Is there any guarantee that the vector control programme will do better than the general health service or Primary Health Care system in supporting community-based activities? What would be the prospect of community-based vector control if it has to be integrated into the general health service which is already poor in supporting PHC at the community level? There seem to be no easy answers to these organization and management questions. But indeed they are fundamental problems for the health bureaucracy.

SUMMARY

This brief paper attempts to raise some salient issues for consideration in planning for community participation in vector control. The issues raised are not intended to be exhaustive, neither are they applicable to all countries. However, we do believe that community-based vector control programmes can benefit greatly by following the success and failure of community participation in the national PHC programme.

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Cultural Factors Influencing Community Participation in Vector Control of Malaria and Filariasis in Malaysia

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INTRODUCTION

The concept of community participation in vector control of malaria and filariasis essentially entails a cooperative or partnership relationship between the government and the community in the task of controlling malaria and filariasis in the community. This partnership would involve not only the support of the villagers and their use of the services provided by the Control Programme of the two diseases but also their active participation in the respective activities under each programme. The ultimate aim of this partnership is community self-reliance in health care.

In actuality, the concept of community participation is not a new thing to disease control implementors. It is, in principle, synonymous with community involvement in community development programmes. In the context of malaria and filariasis control, community participation has always been a concern to programme implementors in their pursuance for wider coverage in mass blood examinations and chemotherapy. Now, with the adoption of 'Health for All in the Year 2000' strategy, control programmes for malaria and filariasis are giving more serious attention to the question of improving community participation.

In the context of malaria and filariasis vector control as practised in Malaysia, community participation can be involved in the following activities:

Activities	*Task Involved*
1. Reduction of vector longevity	—Acceptance of and cooperation with the spraying operations, etc.

2. Reduction of vector population —Peri-domestic sanitation.

—Intermittent emptying of water containers, filling of ponds, clearing of pools, planting of trees, etc.

—Prevention of man-made breeding places (i.e., cisterns, disused wells, borrow pits left by building projects, obstructed drains, etc.).

It is seen that the above tasks require the population to understand the purpose of the activities intended and the nature of tasks involved under each activity. The extent of community participation will depend, among other things, on their knowledge about the diseases—their causation and preventive measures. These and some other factors will be briefly discussed below.

CULTURAL FACTORS INFLUENCING VECTOR CONTROL

Knowledge on scientific theory of disease causation and control

Basic to the idea of controlling the vector population is that adequate knowledge should be possessed by the community on the transmission of disease, the identification of breeding places, the importance of spraying and other vector control activities in promoting health. In usual circumstances, the rural communities have very little or no knowledge at all of the scientific theory of disease causation and of preventive measures.This is one reason for the community's refusal to allow blood collection and spraying of insecticides in their homes.

Nevertheless, malaria and filariasis are generally understood by the community as a cause for concern by the Health Office. Their statements that malaria is rampant and that filariasis is dangerous are indications of their awareness of such health problems in the community. However, they have not grasped its wider impact on their health and social and economic life. In one cultural study on filariasis[1] it was shown that 79% of the population studied were of the opinion that filariasis is dangerous but this is mainly because it leads to elephantiasis. In the case of malaria, observations in endemic communities in Kelantan indicate the fear for 'shivering fever'. Once the fever is over the fear is gone.

Evidently the people's perception of malaria and filariasis is based on symptoms of the disease. They have the least understanding of disease transmission. In the above cultural study on filariasis it was also found that less than 10% of the infected group thought that filarial worms were transmitted by mosquitoes.

The people are generally aware about the presence of mosquitoes, their habitats and the effect of their frequent bites on humans, but they have not understood the role of vector as conceptualized in bio-science.

Social and economic status of population

Responses toward the idea of participation in vector control tend to be related to the socio-economic status of the population. Malaria and filariasis largely affect the rural population, which is usually characterised by ignorance, illiteracy, poverty, low health status and social deprivation, in short, the 'vicious cycle of poverty' syndrome. To this phenomenon is related the question of priorities. To go to the community with the idea of vector control may not result in participation but rather in negative response. Only if the people's wishes are known and satisfied will there be hope for people to collaborate with the programme and make it a success. In malaria endemic areas one finds that the more important concern of the people is economic opportunities so that they could raise their income. Equally important to them is their wish for water, electricity, roads and transport. In the course of the economic development process some of these needs have been met, much to the satisfaction of the people, but for many others the situation has remained much like before. The preoccupation with seeking work opportunities in these much depressed areas is thus a hindrance in getting the people motivated to participate in vector control.

Accessibility of endemic areas

From the operational point of view, the accessibility of the malarious and filarious areas remains a major problem in efforts to educate the people on the disease and the importance of vector control. This affects not only the financial agent, but also the time lost when after trekking the remote villages, the control teams find that not all villagers are in and that some houses are closed or empty.

The remoteness of villages, sparseness of population over extensive areas, and the mobility of the population are some characteristics of indigenous or rural populations that control implementors encounter in their operations. As a result of being unable to get to these groups of population there remain pockets of untreated individuals and unsprayed homes. Of particular concern are the migrants in malaria endemic areas. these migrants, who started to move into Kelantan and Perak about two decades ago by the extensive opening of jungle land for agricultural purposes constitute the 'marginal man' in terms of their insecure residential and citizenship status. As such they avoid getting examined for malaria parasites and receiving treatment. Their homes cannot effectively be sprayed either because they are closed, dismantled or of a structure that cannot hold the insecticides. Obviously, these migrants cannot contribute much to vector control activities.

Different political beliefs

It is always said that politicians use the support of the rural population to win their seats in the ruling party. They do this by giving promises to do what the people want most for their community. This has made the community disinterested in solving their own problems, including those of health. Though many a time they have been disillusioned with the political tactics they have not given up hope that some good politicians would one day come to the village and fulfill their promises.

Besides the disappointments there exists much dissatisfaction among them resulting from the so-called political factions in the community. Differences in political beliefs and commitments have divided the community into groups, not only in matters pertaining to political issues but also in religious and health aspects. When campaigns on malaria control are held groups who regard the health staff as agents for the government avoid them. Not only that, they also refuse to allow their homes to be sprayed. In villages where such phenomena are rife total community participation in vector control activities has little hope of success.

Absence of continuing community support

Experience has shown that community support varies with the extent of the endemicity of malaria and filariasis. People tend to cooperate because of fear for the seriousness of malaria and the disfigurement of limbs in filariasis. When malaria cases are reduced the people feel quite relieved and consequently give much less attention to topics on disease causation and disease control. Other priorities now dominate their daily thoughts and behaviour. The JKKK (village committee), already burdened with the multiple commitment in community development, gives health programmes a low priority. To this is added the fact that reduced incidence in the village resulted in reduced visits by control teams, hence reinforcing the belief among the population that the disease is no more a health problem and that community involvement is not necessary.

Rapport between health staff and community

One of the key principles to get community participation is by getting the health staff to work with the communities. To carry this out would mean that the health staff should be familiar with the communities that they serve. This is necessary in order to know the cultural determinants that shape the support of health programmes. The recruiting of staff from the same ethnic background as that of the population has resulted in trust among staff members. Ignorance of health authorities about the personal problems of staff and the cultural gap they encounter in their work has made many of the best field staff less motivated to continue their good service to the community. One consequence of this is that rapport with the community is jeopardized in many instances.

Ineffectiveness of health education

Health education is the means of disseminating ideas about the public health importance of malaria and filariasis. The procedure consists largely of showing posters, photographs, leaflets, films and talks. The themes and captions are usually of a very general nature emphasizing what is malaria or filariasis; what causes them; how persons get the disease, advice on sleeping under mosquito nets; advice on taking regular antimalaria/antifilariasis tablets; and so on.

These posters and leaflets seem impressive but to the rural folk they may not convey the message. For example, the mosquito is drawn very much bigger than its actual size.This leads the villagers to think that only large mosquitoes are dangerous; what they find in the village are harmless ones for they are 'only small'.

Charismatic personality of health staff

Community participation is in principle the effort made on the part of the health staff to gain the support of the community in health programmes. This effort is worked out on the basis of gaining the confidence of the community in understanding the benefits of the programme and in stimulating the people to change their behaviour. Obviously, this task calls for some qualities of a charismatic leader from among the health staff.

The role played by such leaders in the implementation of PHC approach to malaria control goes to show the importance of this factor. However, such personalities if available are usually not for long. Their contribution to health programmes is affected by frequent transfers to other departments of health. Their replacements would thus have to start knowing the communities in which their predecessors have worked.

CONCLUSIONS

Cultural factors pertaining to the community that influence disease vector control also operate for disease transmission and control. From the operational point of view, getting the community to participate in the control of malaria and filariasis, is a task necessitating health education. In fact, the term community participation is very much equalled to health education.

In this light, community participation is not just a one-stop process. It is also not a one-part responsibility. As pointed out, it is a partnership process, and it is also a continuous effort on both parties. Though the ultimate aim is to achieve self-reliance in health care on the part of the community, this does not imply that the greater part of this responsibility falls on the community itself. The possibility of getting the people to understand the epidemiological cycle of malaria and filariasis and the methods of controlling them depends on a long and continuous health education process. Obviously, this entails long

periods of work and teaching on the part of malaria and filariasis workers. In the course of this process community leaders are to be brought in to share the part of educating their own family members, friends and kinsmen. With this in view, cultural factors found to influence community participation should be given serious consideration by malaria and filariasis control implementors.

ACKNOWLEDGEMENTS

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Theoretical Models for Community Participation in Disease Control

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INTRODUCTION

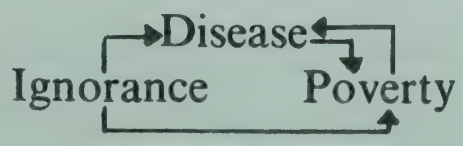
This paper presents certain observations on the projects underway in India, and also remarks on the applicability of community participation approaches in the Indian context.

MODEL BUILDING IN A SOCIAL CONTEXT

A discussion of community participation, cannot afford to disregard the social context. Villages are often so different from each other or to quote Clifford Geertz, villages are often unique socio-culturally. We are facing a myriad of different microcultures. Cultures are complex entities. Models for development are often a collection of principles of approach rather than specific methods of operation or procedure.

It is imperative, that we should always adjust our models to local conditions or situations.

Models are often used to reduce complex entities to simple ones. They are also appropriate to predict events or to guide actions but they are usually not suitable for explaining events. For example, let us take the now famous model of public health:



Apart from the fact that this model is obviously too general in nature to become a suitable one for action, it only points out the inter-relation of three conditions. We can predict that we will not be able to control disease without

paying attention to education and affluency. It also suggests that we attack all of the three conditions simultaneously or select the most vulnerable condition (weakest link).

It does not in any way explain theoretically why poverty breeds disease. At the most it only describes it. Apparently, this model closely resembles Oscar Lewis' description of the culture of poverty, a now rather discredited account of that condition.

For the most effective corrective action we will need to know and attack the principle cause (if possible) of conditions. This model, however, does not in any way explain it. We, therefore, have to support this model with additional social research.

PROBLEM SOLVING APPROACH

There are many models for community development. Long, Anderson and Blubaugh suggest six basic approaches. Among these six, the problem-solving approach is probably the most appropriate one for health professionals for the following reasons.

A. Health professionals including entomologists are already familiar with this kind of approach. It is actually their way of operation.

B. Epidemiologists and entomologists are rightly concerned with their professional standing in a field that has been dominated for so long by physicians. They are, therefore, inclined to stress the professional execution of their task which obviously entails a lack of interest, energy and time for matters not directly related to their jobs. In their line of work, they will accidently encounter certain social problems related to their task which should become the focus of corrective action. It is unrealistic to expect them to use the other approaches with a wider scope, for instance, organising power interest groups.

C. Another reason for suggesting this particular approach is also, because health professionals are often required to achieve and produce results in a definite period of time. The problem solving approach is certainly often less time consuming.

Limitations

Usually the scope of the problem solving approach is limited but it need not be so. Even in broadly stated problems there is a tendency to select practical aspects. We are thereby losing so many opportunities of developing communities in a real sense. Therefore, a holistic approach is recommended for problem solving. Sometimes the core problem may be obscured by peripheral issues. What appears to be a problem at the beginning is often not the real

problem. Thus, a flexible plan is ideal for the problem-solving approach. We should be able to change our programme, whenever the real problem becomes apparent or visible, but this is often difficult to carry out due to previous programme commitments to sponsor agencies. But more important, a limited time scope will often prevent the uncovering of the real problem and its solution.

Another drawback is the limited level of community participation. Again it does not need to be so, the problem-solving approach could easily accommodate community participation as a goal. In practice, however, preoccupation with the original problem will often preclude the development of community participation in a real sense. Participation must be allowed to grow naturally and gradually, a limited perspective is certainly not very conducive to this.

More important, community participation programmes should often at the start avoid controversial issues or problems. They should also preferably take up projects with a high probability of success in order to ensure acceptance by the target community. In the case of the problem-solving approach this often cannot be avoided, specially when there is a limited perspective present.

SOCIAL ROLE OF HEALTH WORKERS

This conference has often been embroiled in heated debate on the appropriate role of health professionals, whether or not they should try their hands at solving community problems not directly related to their job.

In my opinion this problem is irrelevant to the situation in developing countries because the health worker is often the only one available in the field with an academic background. He should of course be aware of his limitations and, therefore, limit his advice and actions accordingly, but this does not exempt him from becoming involved in activities for humanitarian purposes. He should consider the interest of the public paramount over his personal interest and objections.

Let us also not forget that we often only need a healthy dose of common sense, basic human skills and a working knowledge of social factors when we are dealing with society. Besides, health professionals are usually in a more strategic position than social scientists because they are often able to offer more tangible programmes, incentives or rewards.

Aside from this, people often understand their own problems and their solutions already. Our role is then limited i.e., assisting them in contacting the proper official or programme, a task not too heavy for anyone. We also tend to neglect or belittle the personal benefits we are getting from working with people, benefits are certainly not one-sided only.

In conclusion we can say that the health worker should not on any account avoid involvement in community development efforts.

SUPPORT FROM SOCIAL SCIENTISTS

The health worker will certainly need the support of social scientists in all the phases of his work, whenever he is dealing with communities. Societies and social problems are often complex in nature, difficult to observe accurately, difficult to be treated objectively and difficult to experiment with. The operative approach which is adopted by most scientists is often inappropriate for tackling community problems.

Scientists have the tendency to ignore other disciplines, they often function in a cloistered environment. It is suggested that health workers could benefit from interaction with social workers.

EVALUATION

Those who are intimately involved with a social project are inclined to believe in what they are doing, thereby losing much of their objectivity. A good physician believes in his own therapy otherwise he would not deserve to be called a physician. We tend to be carried away by our own actions and success and, therefore, are not in a good position to evaluate our own programme objectively.

For example, the Gujarat project should profit from evaluation by an outside team of scientists, who can look at the programme dispassionately. The selection of such scientists should be done carefully. If they are not involved in the project from the beginning, they will not be able to understand the goings on of the project (Weber's verstehen) to its full extent. This is specially so with projects with a big educational content. The changes in perception, attitude and motivation are difficult to observe and most of the time are very small.

Evaluation cannot be executed immediately, but too large a time lag will make it difficult for us to differentiate the true impact of the project from changes not induced by the project itself.

Other problems of evaluation are:

—The goals are often not well defined or are contradictory to each other.
—Projects are often not carried out consistently.
—Evaluation or monitoring of the project is not executed on a continuous basis, as a consequence, certain information is lost.

The most common type of evaluation, evaluation by objectives is, therefore, often of a limited value.

Even so the evaluation of the Gujarat project is recommended. It is obvious that they have to engage an experienced social scientist.

HOLISTIC APPROACH

There are different kinds, levels and degrees of participation. There are also different perceptions, attitudes and motivations to community participation in a particular health project. It is certainly true that not every programme/project will need the same kind, level or degree of participation. The most ideal model, the holistic model, that tries to take into account the whole community, all their needs, interests and all their ideas will only be feasible, in a small and isolated community.

Specificity of community needs, so often recommended as the starting point of a social action programme by armchair professionals; has dubious feasibility in actual practice, because we either get a long list of specific complaints and requests or receive no response at all. In addition, the aims of a programme are often determined elsewhere so are its needs.

A model that has been used in Indonesia to establish the felt needs of a community is the participatory model, i.e., assembling people and stimulating them to discuss their own health problems and planning their own health programme. Its main drawback is that, often no outside assistance is forthcoming. Most of the potential support from outside resources is tied to specific programmes.

COMMITMENT AND IMPLEMENTATION

One basic question that has to be answered by health workers is, whether we are really committed to the essential idea of community participation. Professionals are in general extremely reluctant in transferring their prerogatives to other people, specially lay people. If we are serious about implementing the principles of self reliance and self improvement our programmes should certainly show that and should be planned accordingly. What we actually see are programmes which are turning community problems into technical ones. This is concretisation of problems in a mechanistic or instrumental way of seeing things.

As Dr. Rosenfield so often pointed out during the conference many health programmes that are so-called models for community participation are on closer look nothing but ways of securing a cheap source of labour or funding. We are fooling nobody but ourselves by pretending that such programmes are community participation programmes.

An important and often forgotten consequence of any real and genuine community participation programme is the gradual transformation of the

community into a power conscious group, that actually begins to demand a say, in at least their own affairs.

Another basic question of implementation is whether professionals are really able to handle the programme on their own, whether they are even the most important component in the control of communicable diseases. The role of the public is so often forgotten. The eradication of smallpox would not have been possible without the cooperation of numerous organisations and communities.

THE HUMAN FACTOR AND TECHNOLOGY

It is certainly true, that man in many instances is the source of many programme difficulties and problems. He is often considered to be the weakest link, the unpredictable factor in any health programme. A health programme which relies less on people's cooperation and more on technology will often turn out to be more successful. It is also more easy to manipulate technology than persons, social groups, values and norms.

However, this must not blind us to the fact, that technology does have its limitations. The concept of appropriate technology already accepted everywhere, is evidently proof of the unfeasibility of modern technology under certain circumstances. However, in practice too much emphasis has been placed on deliberations about appropriate technology as an alternative to modern and traditional technology rather than on its actual development and even less on its marketing. Mainly catering to the needs of the less affluent it is difficult to see it as a viable concept. There is often no effective demand for this kind of technology.

Government could certainly step in by purchasing and distributing its products to those who are in need. But in the long run this usually becomes a very expensive undertaking. In addition so many needs and problems in the field do not receive any attention and response at all from industries and technologists.

The above mentioned principles generally also apply to innovation. A third principle could be added, that is social and political acceptability. I have personally been involved on four different and separate occasions in programmes that were promoting the use of soakage pits, smokeless ovens and pit privies with always the same and saddening outcome, no lasting or permanent change in behaviour of village people was found in relation to those technologies. Appropriate technology turned out to be not so appropriate after all.

Foster's book on traditional culture and technological change is a rich source of information on this matter but even his accounts are probably too simplistic.

We tend to forget that there are many factors involved, so often related to each other. Parallel changes on the cultural level, the societal level as well as the personal level are necessary, when a new technology is being introduced. The adoption of even soakage pits has to be supported by a change in patterns of sweeping, periodic cleansing, security measures etc. Minute things have to be considered and smaller steps than have been visualized beforehand have to be taken. We usually do not have the time, energy or the stamina to see such projects through and, therefore, have to rely on the community itself to preserve the changes. Community participation is a necessity. In essence, we have to consider the feasibility as well as the profitability of technology whenever and wherever we are applying it in the field.

MOTIVATIONAL PRESSURES

Health technologies have a distinct disadvantage. How do we demonstrate the benefits concretely? This is even more so for preventive measures. Does immunisation benefit the individual and his close family or does it mainly benefit the community?

So many surveys have already shown that the main motivation of many villagers for compliance with health stipulations/programmes is their conformity to local norms and community pressure. Why do we still insist on the use of the individual approach, a relic from the past, when physicians were attacking health problems on an individual base? Our agriculture colleagues are mainly using the group approach with excellent results, while we are still clinging to home visits and individual counselling.

We almost always assume that rationality is the most important ingredient of our approach, that people have to understand our message first before they are ready to take any steps, any measures, that appealing to their rational faculties is the most strategic approach.

So much has been written on this particular subject, that a school of social theorists has grown up around it. Rationality and irrationality for that matter have always been a base for judging people. In the past, subsistence farmers were often considered to be less rational, but Schutz and Tegugalpa have convincingly proven this to be wrong. They were actually executing their task rationally when we take into account their circumstances, because they avoid taking any risks that could possibly threaten their existence. They are, therefore, not very cooperative when it comes to the adoption of new technologies, a new crop, new ways of planting or the use of herbicides and insecticides.

Communication specialists may be mistaken in using rationality as the cornerstone of their main model.

Psychologists, Maslow for instance, have pointed out that thinking is not as fundamental as need, drive and perception. According to Maslow, Man has an inherent tendency for coping whenever he faces a problem. Looking for explanations is not as fundamental as these tendencies.

So we can tentatively propose an alternative Hirschi's scheme on participation. According to him, there are different degrees of participation i.e., attachment, commitment, involvement and belief. But these steps can be shown as a sequence which will ultimately lead to full participation.

In attachment people are already taking into account the opinion and interests of other group members. There is a feeling of obligation to others and of consideration of one's relation with others as guides to conduct.

Commitment is expressed in the investment of time and energy in a chosen way of living. It is the rational component in conformity.

Involvement means, if one chooses a patterned existence, some lines of action are opened and some lines are closed. There is generally a constriction of our actions demanded by a chosen way of living.

Belief means the acceptance often irrationally of the moral validity of rules. If we apply this scheme to events in Gujarat, we would come to the conclusion that at the most only the level of commitment has been achieved so far.

If we combine Maslow's concept and Hirschi's scheme we can draw the inference that rationality as well as goaldirectness far from being the most important element are essentially subordinate to conformity to social norms and group sentiment.

Goaldirectness is also often working against group solidarity. Whenever a group is trying to achieve or reach a goal, some members will always be left behind. This fact is working against group cohesiveness. But the group is always trying to maintain its cohesiveness, so at the same time group members are taking steps by imploring and cajoling its marginal members to comply with group activities.

Communities are not always harmonious entities. Communities differ in the degree of integration or cohesiveness from each other.

Banfield in his famous study on communities in south Italy discovered the existence of so called non-communities, communities with no sentiment of solidarity at all.

Conflict among the members was its predominant feature, no common activities were possible, no socialising was present. It is obvious that we cannot employ community participation in such a context. We have to deal with groups or individuals on a separate basis and assist the community in reaching a modicum of consensus on our programme.

CONCLUSION

I am deeply impressed by the serious efforts of my Indian colleagues, Dr. Sharma in particular. Their dedication is certainly exemplary in all its aspects and I wish them all the success in the world.

A dedicated, idealistic but realistic and strategically placed leader is certainly a very important asset in a community development programme. However, this may also be one of its main liabilities. Its implementation on a larger scale for instance will require other pre-conditions like the political will of government, organisations and organisational skills etc.

The almost inevitable bureaucratisation in particular will possibly have a devastating impact on this project's application in a wider context, dedication in particular will almost certainly fall victim to it.

I, therefore, suggest that these projects (Gujarat and Pondicherry) be treated as a pilot project. My Indian colleagues will then be required to evaluate their activities more thoroughly.

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